INSTALLATION RESTORATION PROGRAM

PRELIMINARY ASSESSMENT/ SITE INSPECTION REPORT

LOVELL FIELD AIR NATIONAL GUARD STATION
241st ELECTRONIC INSTALLATION SQUADRON
TENNESSEE AIR NATIONAL GUARD
CHATTANOOGA, TENNESSEE

JULY 1995

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
31 JULY 1995

3. REPORT TYPE AND DATES COVERED
Preliminary Assessment/Site Inspection Report1959-1995

4. TITLE AND SUBTITLE
Preliminary Assessment/Site Inspection Report
Lovell Field Air National Guard Station, 241st Electronic Installation Squadron
Tennessee Air National Guard, Chattanooga, Tennessee

5. FUNDING NUMBERS

6. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT NUMBER
Contract No. DAHA90-92-D-0004,
Delivery Order 0007,Deliverable 3C

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Air National Guard
ANG/CEVR
3500 Fetchet Avenue
Andrews AFB MD 20762-5157

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
18-A-45-2-1

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*
This report presents the results of the Site Inspection conducted October 1994 by AEPCO, Inc. at the Lovell Field Air National Guard Station, located at Chattanooga Municipal Airport, Hamilton County in Southeastern Tennessee. The preliminary assessment and site inspection (PA/SI) is a mechanism for confirming the presence or absence of contamination in the environment through a field sampling program as part of the Installation Restoration Program.
The Station has actively operated since 1959 to support air communication services. Operations have involved the use and disposal of hazardous materials and wastes. One area of concern (hereafter referred to as "AOC A"), an area adjacent to and northwest of Building 100, was identified at the Station. Three piezometer monitoring wells were drilled and installed, then sampled for Volatile Organic Hydrocarbons, metals, and total petroleum hydrocarbons following soil detections. All laboratory analytical results were below regulatory limits, except for one groundwater detection of lead at 22.1 micrograms per liter, which is slightly above the Safe Drinking Water Act Maximum Contaminant Level of 15. However, since this is not a potable well, lead is not a groundwater contaminant of concern for this Site Inspection. Based on these results, there are no contaminants at AOC A that pose a risk to potential receptors. Accordingly, no further action is required at AOC A under the Air National Guard's Installation Restoration Program. This conclusion was confirmed by the State of Tennessee's Department of Environmental Conservation, who agreed with site closure in June 1996.

14. SUBJECT TERMS

15. NUMBER OF PAGES
130

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	

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LIST OF ACRONYMS AND ABBREVIATIONS

AACS	Airway and Air Communication Support
ADPM	Automated Defense Priority Modeling
AEPCO	Advanced Engineering & Planning Corporation, Inc.
AGE	Aerospace Ground Equipment
AMSL	Above Mean Sea Level
ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
ANGRC/CEVR	Air National Guard Readiness Center/Civil Engineering Group
ANGS	Air National Guard Station
AOC	Area of Concern
AOC A	Area of Concern -- Area Behind Building 100
ASTM	American Society for Testing and Materials
ArB	Arents Soil Group
BGS	Below Ground Surface
C	Celsius
CdC	Colbert-Urban Land Complex Soils
CEM	Communication-Electronics-Meteorological
CFR	Code of Federal Regulations
CMA	Chattanooga Municipal Airport
COCA	Cambrian-Ordovician Carbonate Aquifer
CON	Consumed In Use
DOA	Department of Agriculture
DoD	Department of Defense
DOT	Department of Transportation
DRN	Disposed of Through The Public Sewer Drain
DRMO	Defense Reutilization and Marketing Office
EIS	Electronic Installation Squadron
F	Fahrenheit Temperature
FFS	Focused Feasibility Study
FOL	Field Operations Leader
FS	Feasibility Study
GND	Disposed of on Ground
GSU	Geographical Separate Unit
HASP	Health and Safety Plan
HI	Heath Index
ID	Inside Diameter
IRP	Installation Restoration Program
l	Liter
m	Meter
mg/Kg	Milligrams per Kilogram
ml	Milliliter (10^{-3} *l*)
MANUF	Returned to Manufacturer for Disposal

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

MEK	Methyl-Ethyl Ketone
NCP	National Contingency Plan
ND	Non-Detect
NEU	Neutralized
NGB	National Guard Bureau
PA/SI	Preliminary Assessment Site Inspection
PID	Photoionization Detector
PM	Project Manager
PE	Polyethylene
ppm	Parts per Million
PVC	Polyvinyl Chloride
PZ	Piezometer
OD	Outside Diameter
OWS	Oil Water Separator
QA	Quality Assurance
QAO	Quality Assurance Officer
QA/QC	Quality Assurance/Quality Control
RAGS	US EPA Risk Assessment Guidance for Superfund
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RM	Remedial Measures
SB	Soil Boring
SS	Surface Soil Sample
TDEC	Tennessee Department of Environment and Conservation
TPH	Total Petroleum Hydrocarbons
TVA	Tennessee Valley Authority
TUSTCS	TDEC, Underground Storage Tank Removal Cleanup Standards
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WP	Work Plan
241st EIS	241st Electronic Installation Squadron
μg/Kg	Micrograms per Kilogram
μg/l	Micrograms per Liter
UST	Underground Storage Tank
WMJ	Wide Mouth Jar

EXECUTIVE SUMMARY

This report presents the results of the Site Inspection conducted during October 1994 by AEPCO, Inc. at the Lovell Air National Guard (ANG) Station (ANGS), (herein referred to as "the Station"), located at Chattanooga Municipal Airport, Hamilton County in Southeastern Tennessee. The preliminary assessment and site inspection (PA/SI) is a mechanism for confirming the presence or absence of contamination in the environment through a field sampling program as part of the Installation Restoration Program (IRP).

The Station has actively operated since 1959 at this location to support air communication services. Operations have involved the use and disposal of hazardous materials and wastes. One area of concern (hereafter referred to as "AOC A"), an area adjacent to and northwest of Building 100, was identified at the Station. Two sites within this AOC A were investigated to determine if they posed as a source of contamination. Historical activities and the PA/SI results are summarized for this AOC A in the following paragraphs.

AOC A is located near the northwestern side of the Station adjacent to Building 100, and it currently exists as a gravel covered area and a bituminous concrete parking lot. Between 1959 to 1975, unknown quantities of waste oil and hydraulic oil, and small quantities of transmission fluid were dumped behind Building 100 at this Site. A waste oil storage facility, located adjacent to Building 103 is also included in AOC A where waste oil has been stored since 1975. Vegetative stress is evident in this area which, on average, accumulated/stored up to four 55-gallon drums per year of waste oil.

VOCs, metals, and total petroleum hydrocarbons (TPH) were detected in soil borings at scattered locations within AOC A. Acetone, methylene chloride and 2-butanone were detected at concentrations ranging from non-detect (ND) to 6,400 $\mu g/Kg$. 9.31 to 33.8 $\mu g/Kg$, and ND to 6.9 $\mu g/Kg$, respectively. These levels were determined to represent an insignificant health risks. TPH concentrations, which ranged from ND to 108 *mg/Kg*, do not exceed the Tennessee Department of Environment and Conservation, Underground Storage Tank Removal Cleanup Standards (TUSTCS) of 500 *mg/Kg* for soils over a drinking water aquifer. TPH (91.5 *mg/Kg*) was also detected in the drill cutting from PZ-3 located in the middle of a active parking area. The metal concentrations detected were all within expected background levels. No further action is required for AOC A soils.

Although several volatile organic compounds (VOCs) were detected in ground water collected from the Station's piezometer wells, these trace concentrations were below TUSTCS or were determined to pose no significant health risk.

Several priority-pollutant metals were detected in the filtered ground water samples from the piezometer wells. Except for lead, in the filtered ground water sample from PZ-2, these metals

all fall within the native background range. In PZ-2, the lead concentration of 22.1μg/l slightly exceeds the Safe Drinking Water MCL (Treatment Technique Action Level) of 15 μg/l and the eastern U.S. background level of ≤ 15 μg/l. The source of the lead in this side gradient well to AOC A is unknown. However, since PZ-2 in not a potable well, lead is not a ground water contaminant of concern for this Preliminary Assessment/Site Inspection.

Based on the results of the PA/SI, there are no contaminants at AOC A that pose a risk to potential receptors. Accordingly no further action is required at AOC A under ANG's IRP.

1.0 INTRODUCTION

As required by Executive Order 12580 (January 23, 1987), the Department of Defense (DoD) has developed a program to identify and evaluate sites on DoD property where contamination may be present due to past spills or waste disposal practices. This program is the IRP, and its function is to identify the presence of contaminants and to control hazards to health, welfare, or the environment that may result from their presence. The Air National Guard Readiness Center (ANGRC) under the National Guard Bureau (NGB) has instituted its own Installation Restoration Program (IRP) consistent with DoD's. This Preliminary Assessment/Site Inspection (PA/SI) report has been developed as part of the IRP conducted for the ANGS located near Lovell Field, Chattanooga, Tennessee. The PA/SI presents the results of the investigation that determines the existence of contamination and responding action for one previously identified area of concern (AOC A). The contractor, Advanced Engineering & Planning Corporation, Inc. (AEPCO) submits this PA/SI report under contract with the Air National Guard Bureau.

1.1 Objectives and Scope of Report

This report presents the results of the site investigation conducted by AEPCO at the Lovell ANGS (herein referred to as "the Station"). This report also describes the project activities and presents the data collected during the PA/SI. To clarify pertinent procedures utilized during the PA/SI the reader of this report should have access to the PA/SI Work Plan (AEPCO, Inc., 1994).

The specific objectives of the PA/SI were to confirm or deny the presence of contamination in soil and/or groundwater beneath the Station, detect and characterize contaminants, and assess the risks to potential receptors.

The Station has operated since 1959 at this location to support air communication services. Operations have involved the use and disposal of hazardous materials and wastes. AOC A is an area adjacent to and northwest of Building 100, which contains two locations where hazardous material was used or disposed of at the Station. Record searches identified these two areas as locations where wastes had been managed and spills could have occurred in such a way that environmental damage could have resulted. PA/SI activities included identifying potential contaminants at these locations through field screening for contaminants, drilling of soil borings to collect stratigraphic information and soil samples for chemical testing, installation of piezometers, and groundwater sampling from the piezometers. The results of the field investigation were used to perform a hydrological assessment, soils and water quality evaluations, and a preliminary evaluation of the risks to potential human or environmental receptors.

The information obtained from the field investigation guided decisions on proceeding with one of the following actions for AOC A:

- No Further Action if analytical data confirms absence of contamination at AOC A;
- Initiation of a Remedial Investigation/Feasibility Study (RI/FS);
- Conduction of a Focused Feasibility Study/Remedial Measures (FFS/RM); or
- Implementation of immediate response actions.

1.2 Report of Organization

This report describes AOC A and the PA/SI investigations completed under this project. The methods of data collection and quality assurance (QA) procedures utilized during the investigation are described. Finally, the site is characterized with respect to its setting and evident contamination, and general recommendations are presented concerning any future investigations or actions deemed necessary.

This PA/SI Report is contained in one Volume. **Section 1.0** of this report that is an introduction to the report and an overview of the area of concern that were investigated. **Section 2.0** describes the regional and Station specific environmental setting. The field sampling plan, investigative methods and procedures, quality control, documentation, sample handling procedures, equipment decontamination, investigation-derived waste handling procedures, and borehole abandonment procedures are described in **Section 3.0**. **Section 3.0** also describes in detail the field and analytical activities that took place to accomplish the work and laboratory analysis. **Section 4.0** discusses the results of the field investigation. Summary and conclusions are addressed in **Section 5.0** and recommendations are discussed in **Section 6.0**. The report is supplemented by five appendices that presents:

- The Technical Memoranda (Appendix A);
- Analytical Data and Laboratory QA/QC Evaluation Results (Appendix B). This appendix was provided to ANGRC under separate cover;
- Soil boring logs (Appendix C);
- Automated Defense Priority Modeling (ADPM) Ranking; (Appendix D) and
- Federal Facility Docket Site Data Requirements (Appendix E).

1.3 Facility Background

The Station is located in south-central Hamilton County at the southeastern side of the Chattanooga Municipal Airport (CMA), Chattanooga, Tennessee at 85°12'5" W longitude and 35°1'36" N latitude (**Figure 1-1**). The 241st Airway and Air Communication Support (AACS) Operations Flight was originally formed on August 6, 1952, with 2 officers and 36 airmen assigned to active duty. Its mission was to achieve and maintain a level of operational effectiveness that would enable the unit to operate airway and air communication service facilities as directed. In August 1959, the unit moved into its present location with an authorized strength of 22 officers and 149 airmen. Since then, several reorganizations and redesignations have taken place, but with little or no change in mission. In December 1982, the organization was redesignated from the 241st Electronics Installation Squadron to the 241st Engineering Installation Squadron (241st EIS), with an authorized strength of 10 officers and 169 airmen. The assigned mission of the 241st EIS at that time was to develop and maintain the capability to provide engineering, installation, removal and relocation, and maintenance of ground communications-electronics-meteorological (CEM) systems.

LEGEND

LOVELL FIELD ANG PROPERTY

0 1/4 1/2 1 MILE

SOURCE: U.S.G.S., 7.5 MINUTE SERIES TOPOGRAPHIC QUANDRANGLE EAST CHATTANOOGA, 1969, PHOTOREVISED 1976

AEPCO

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FIGURE 1-1
LOCATION MAP OF
241st EIS, TENNESSEE AIR NATIONAL GUARD
CHATTANOOGA, TENNESSEE

In October 1991, the 241st EIS mission was changed to a wartime type responsibility to mobilize and deploy authorized resources and supporting assets to accomplish the engineering, installation, reconstitution, and/or replacement of communications-computer systems. The current authorized strength is 10 officers and 165 airmen. The Station maintains 49 vehicles and 23 pieces of Aerospace Ground Equipment (AGE) equipment.

The Station is a Geographical Separated Unit (GSU), in that the Station is in a remote location detached from its' Command Unit. It does not maintain any environmental records or documents; with environmental compliance support being handled by the Nashville ANG.

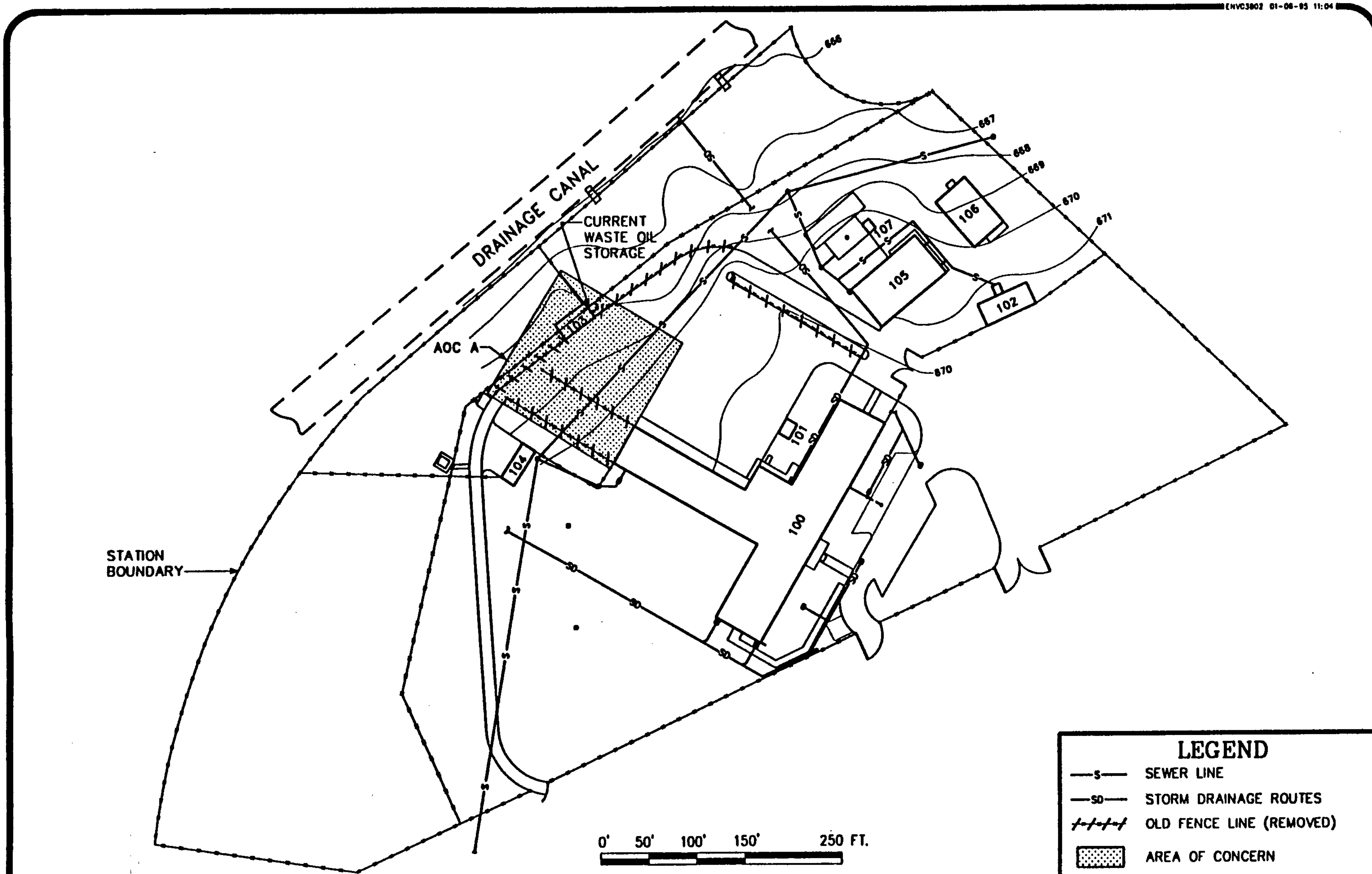
The Station's mission includes:

- Installation engineering;
- Installation, removal and field maintenance of communications and electronic equipment; and
- Maintenance of assigned vehicles.

1.3.1 Site Description

The Preliminary Assessment process consisted of an on-site visit, records search, and interviews. Knowledgeable ANG employees, both past and present, were contacted about the hazardous material/waste operations and practices conducted at the Station. The AOC A is located northwest of Building 100, as shown in **Figure 1-2**. The area is immediately adjacent to Building 100 and is graded away from Building 100 at a slope of ~1/100. AOC A is covered by gravel and bituminous paving used for parking and a small grass covered area. The parking area is used for military trucks and military construction vehicles. Numerous small spills are evident throughout the parking lot. Building 103 is located in AOC A and has adjacent to its northeast side a waste oil storage facility. Currently the storage facility is equipped with a concrete secondary containment base and has a lean-to roof to provide shelter from precipitation. Waste oil is stored in drums which are electrically grounded.

Between 1959 to 1975, unknown quantities of waste oil, hydraulic oil, and small quantities of transmission fluid (totaling between 100 to 300 gallons per year) were dumped behind Building 100. This is also where an additional garage pit and paint booth were built in the 1970's. Additional dumping occurred along the nearby fence line which has since been removed. Although at least 222 cubic yards (20 x 20 x 15 ft deep) of soil were excavated during the construction of the garage pit and paint booth, the old fence line appears to be beyond the excavated area (supported by a 1969 aerial photo obtained from the Hamilton County Planning Office).



AEPCO

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FIGURE 1–2
AREA OF CONCERN
241st EIS, TENNESSE AIR NATIONAL GUARD
CHATTANOOGA, TENNESSEE

Since 1975, waste oil generated by activities at the Station has been containerized for proper disposal. The drums of waste oil were stored in a gravel area along the fence line, north of Building 103. In 1990, a new storage area was constructed with a cover, concrete floor with dikes and a drainage plug. The quantity of waste oil accumulation under regulated conditions during the period 1975 to 1990 averaged a maximum of four 55-gallon drums per year.

1.3.2 Facility/Site History

The population of Chattanooga was 152,466 in 1990 (Regional Planning Commission of Chattanooga/Hamilton County, March 1992) which includes the area surrounding the Station. Within a 0.5-mile radius of the Station, the population is approximately 700. The daytime population of the Station is normally 18 persons. During training weekends, a maximum of 175 people may be present.

The elevation of the Station ranges between 667 and 683 feet above mean sea level (AMSL) and runoff from the Station discharges to a drainage canal behind the northern fence line. The Station is connected with a public water supply (Tennessee-American Water Company) and sewer system (Chattanooga Municipal Public Works, Moccasin Bend Sewer Treatment Plant). No wells are located on the Station.

Throughout its history, activities at the Station have involved use of materials and the generation of various wastes, some of which may be considered hazardous. Most of the wastes generated at the Station have been from vehicle maintenance. These wastes include:

- Solvents;
- Battery Acid;
- Antifreeze;
- Waste engine oil, transmission, brake and hydraulic fluids, and
- Paint and paint thinner.

Quantities of wastes historically generated, applied and/or disposed of at the auto shop/power shop are shown in **Table 1-1**. Information on the use of these chemicals, wastes generated, and disposal practices identified during the Preliminary Assessment (**Section 1.4.1**) at the Station are summarized below:

- Waste Oil/Transmission, Brake and Hydraulic Fluids

    Prior to the 1970's, the Station did not have a proper waste management program. Unknown quantities of waste oil and hydraulic oil, and small quantities of transmission fluid were dumped behind Building 100 (where an additional garage pit and paint booth were built in the 1970's) and also along the nearby fence line which has since been removed. Since the early 1970's, these wastes have been

Table 1-1 Quantities of Materials Used, Wastes Generated and Disposal Methods at AOC A

SHOP		QUANTITIES DISPOSED PER/YEAR	DISPOSAL/APPLICATION METHODS			
			1960s	1970s	1980s	1990s
AUTO SHOP/ POWER PRODUCTION	Solvents/PD-680 (MEK/Xylenes/Toluene)	8 gal.	CON	CON	DRMO	DRMO
	Battery Acid	10-15 gal.	NEU /OWS	NEU/OWS	MANUF	MANUF
	Paint/Paint Thinners	8 gal.	CON	CON	CON	DRMO
	Waste Oil/Transmission, Brake and Hydraulic Fluids	250 gal.	GND	GND /DRMO	DRMO	DRMO
	Antifreeze Fluid	15 gal.	DRN	DRN	DRN	DRMO
	Pesticides/herbicides	5 gal.			GND	GND

CON - Consumed in use
DRMO - Disposed of through the DoD Reutilization and Marketing Office
GND - Disposed of on ground
NEU - Neutralized
OWS - Oil/Water Separator
DRN -Disposed of through the public sewer drain
MANUF -Returned to manufacturer for disposal

(Waste Oil/Transmission, Brake and Hydraulic Fluids continued) drummed, stored at a waste storage area beside Building 103, and then transported to the Defense Reutilization and Marketing Office (DRMO) at Ft. Campbell, Kentucky. Waste oil is presently transported to Nashville by the Tennessee ANG at Nashville.

- Antifreeze

  In the past, antifreeze was poured down the shop floor drain, which leads to the public sewer system. Since the early 1990's, antifreeze has been drummed and shipped by the Tennessee ANG at Nashville to the DRMO.

- Solvents

  Small quantities of solvent PD-680 that contains methyl ethyl ketone (MEK = 2-butanone), xylenes, and toluene that were used and any recoverable spent solvents were containerized and allowed to evaporate onsite. Since 1980 these solvents have been drummed and shipped by the Tennessee ANG at Nashville to the DRMO.

- Paint/Paint Thinners

  Small quantities of paint were disposed of as domestic garbage, and paint thinners and solvents were containerized and evaporated onsite. Since 1992, paint thinners and solvents have been drummed and shipped by the Tennessee ANG at Nashville to the DRMO

- Battery Acid

  Quantities of battery acid were neutralized to pH 7 and run through an oil/water separator unit. The water component of the battery neutralized acid was disposed through the public sewer system. The oil component was incorporated into the waste engine oil stream. Since the 1980s battery acid has been returned to the manufacturer for disposal.

- Pesticides/Herbicides

  Since 1987, about 5 gallons per year of Roundup™ (herbicide) have been used to kill the grass along the Station fence line. Empty drums of Roundup™ are disposed as domestic waste. Pesticide spraying is conducted by trained Nashville ANG staff once or twice a year.

- Oil Water Separators Discharge

  An Oil Water (O/W) separator is located at Building 100 to receive the effluent from floor cleaning operations in the garage pit. There is another inactive O/W separator at Building 105. No maintenance records were available for either O/W separators. Both separators drain to the public sewer system (Chattanooga Municipal Public Works, Moccasin Bend Sewer Treatment Plant) and show no sign of leakage. The oil component was incorporated into the waste engine oil stream. Thus no further investigation is necessary.

1.4 Previous Program Activities

Activities completed for the PA/SI are discussed in the following paragraphs.

1.4.1 Preliminary Assessment/Site Inspection

The PA/SI process consisted of personnel interviews and a records search designed to identify and evaluate past disposal and/or spill sites that might pose a potential and/or actual hazard to public health, public welfare, or the environment. Previously undocumented information was obtained through the interviews. The records search focuses on obtaining useful information from aerial photographs, Station plans, facility inventory documents, lists of hazardous materials used at the Station, Station subcontractor reports, Station correspondence, Material Safety Data Sheets, Federal/State agency scientific reports and statistics, Federal administrative documents, Federal/State records on endangered or threatened species and critical habitat, documents from local government offices, standard reference sources, and on-site sampling.

1.4.1.1 Preliminary Assessment Interviews

A total of seven employees knowledgeable of former and present waste disposal practices at the Station were interviewed by both ANGRC and AEPCO personnel on 27 and 28 October 1993. Each interviewee was questioned about the Station's past and current waste generation and handling, underground storage tank (UST) status, spills, and operation problems.

1.4.1.2 Preliminary Assessment Records Search

Records contained in the Station files were collected during the course of the site visit and reviewed to supplement the information obtained in the interviews. Detailed geologic, hydrologic, meteorological, and environmental data for the area were obtained from the appropriate Federal, State, and local agencies prior to, during, and shortly after the 27 to 29 October, 1993 site visit. These agencies include:

- United States Geological Survey (USGS)
  - geological information
  - hydrological information

- Tennessee Department of Environment and Conservation (TDEC)
  - State regulations

- Hamilton County Office/Planning
  - population
  - number of wells
  - zoning and land use
  - aerial photos (1969, 1980, 1990)

- City Engineering
  - wetland locations
  - flow rate of the unnamed tributary (drainage canal) to Chickamauga creek

- Department of Environmental Health
  - public water suppliers and their water sources

1.4.1.3 Preliminary Assessment Recommendations/Conclusions

During the site inspection meeting two potential AOCs (Area behind Building 100 and Truck Wash Pad) were initially identified as requiring further evaluation. Based on subsequent information gathered and evaluated by ANGRC/CEVR and base personnel, it was determined that the truck wash pad area (AOC B) did not pose a threat from contaminants because the runoff from this pad was directly discharged into the Chattanooga Municipal Public Works, Moccasin Bend Sewer Treatment Plant. Thus, no further investigations were required on this AOC.

Therefore, only one AOC (designated AOC A) required further investigations at Lovell Field ANGS to determine the presence or absence of contamination, and to evaluate the potential for contaminant migration. Soil and groundwater samples would be collected during the site inspection.

A PA/SI Work Plan (WP) (AEPCO, August 1994) was completed and followed by the Field PA/SI activity.

1.4.2 Site Investigation/Sampling

The Site Investigation on site sampling activities were initiated on October 23, 1994 and completed on October 29, 1994.

A Site Investigation sampling activities preparatory meeting was held at Lovell Field on 24 October 1994, and was led by two representatives from the ANGRC. The purpose of this meeting was to initiate the Site Investigation for the Station's 241st EIS.

Activities performed during this Site Investigation initiation meeting were:

- On-site Utility Records Search;
- Scheduling of PA/SI sampling activities;
- Project Team Discussion; and
- Layout of Piezometers, Decon Pad, Borings, and Soil Screening.

2.0 REGIONAL ENVIRONMENTAL SETTING

2.1 Meteorology

DeBuchananne and *Richardson* (1956) describe that Hamilton County lies in the south eastern section of Tennessee in an area that generally does not experience the normal cross continental pathway of low pressure storm fronts. Storms generally come from disturbances generated in the Caribbean Gulf and/or, to a lesser extent, from northeastern moving storms generated around Oklahoma. Weather conditions are generally stable when compared to the Atlantic seaboard and the northeastern states but less stable when compared to the far southwestern states.

Temperatures follow a normal northern hemisphere pattern with July being the hottest month and January exhibiting the coldest monthly temperatures. The average last frost is March 30 and the first frost occurs around October 30 for Hamilton County. Average monthly temperatures are shown in **Table 2.1**

TABLE 2.1 Average Monthly Temperatures and Precipitation for Chattanooga Airport

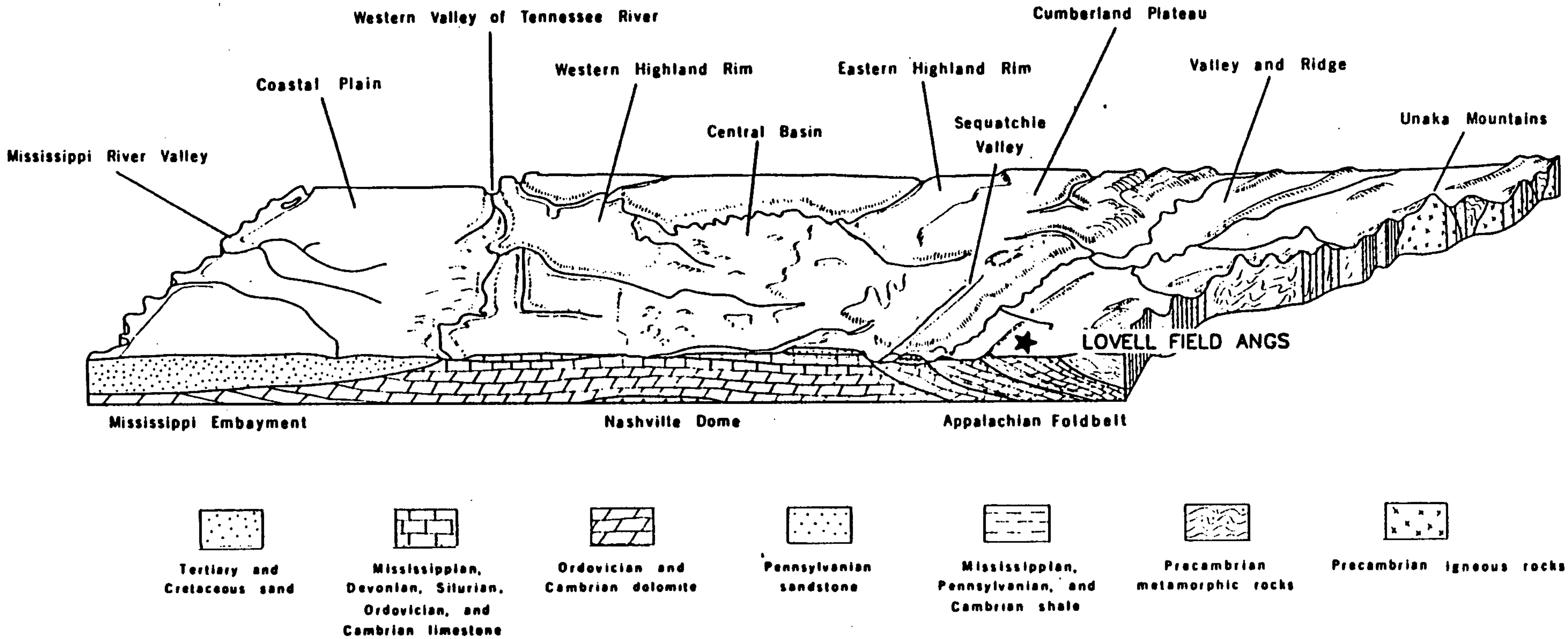
Month	Temperature (°F) (1937 to 1950)	Precipitation (inches) (1937 to 1950)
January	39.1	5.26
February	42.2	4.88
March	49.1	5.78
April	57.6	4.85
May	65.5	3.77
June	72.2	4.16
July	77.4	4.25
August	75.7	4.03
September	68.2	3.11
October	57.7	3.01
November	47.9	3.36
December	40.9	5.13

DeBuchananne and Richardson (1956)

Annual precipitation in Hamilton County totals over 50 inches with average monthly amounts presented in **Table 2.1**. About 60% of the annual precipitation is released back into the atmosphere through evapo-transpiration. Regionally, the remaining 40%, approximately one-third infiltrates to groundwater, and the rest is runoff but at the Station very little precipitation infiltrates.

2.2 Geology

The western quarter of Hamilton County lies within the "Cumberland Plateau" physiographic province, while the eastern three-fourths is within the "Valley and Ridge" region (**Figure 2-1**).



LEGEND

★ LOVELL FIELD ANG STATION

SOURCE: ROBERT A. MILLER, THE GEOLOGIC HISTORY OF TENNESSEE, 1974

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FIGURE 2–1
GEOLOGICAL RELIEF–MAP OF PHYSIOGRAPHIC UNITS OF TENNESSEE
241st EIS, TENNESSEE AIR NATIONAL GUARD

The Station and CMA are situated in the "Valley and Ridge" region, as stated in the *Geology of Hamilton County* (1979). The region is sometimes referred to as the Valley of East Tennessee, which is characterized by numerous elongated ridges and intervening valleys, all trending in a northeast/southwest direction. This orientation is the result of folding and fracturing during a mountain building episode 230 to 260-million years ago. These ridges are mainly at elevations of between 900 and 1,100 feet (274-335m) AMSL. The highest ridge, Whiteoak Mountain, is 10-miles east of the Station and averages nearly 1,500 feet (457 m) in elevation. The topography of the Station is relatively flat, ranging from 666 to 671 feet AMSL. The elevation of AOC A runs between 669 to 671 feet AMSL.

The geological formations described by *Wilson* (1989) within the Station boundary include Quaternary alluvial deposits and an unspecified limestone of the Ordovician Age Stone River Group (**Figure 2-2**). The major buildings of the Station (e.g., Buildings 100, 102, 105, 106) are located on the Stone River Group limestone, while north-northwest of these buildings are the alluvial deposits. These deposits, which are up to 20 feet thick, include clay, silt, sand, and gravel, unconsolidated and poorly sorted; they contain subangular to subrounded pebbles or chert, quartz, and quartzite. The Stone River Group limestone of the Ordovician Age includes, from most recent to oldest, the Carers, Lebanon, Ridley, and Murfeesboro Limestone, and the Pond Spring Formation (**Figure 2-3**). The Stones River Group typically exhibit karst weathering patterns and the resultant topography (*Geology of Hamilton County, Tennessee, Tennessee Division of Geology*). The Pond Spring Formation, which is up to 350 feet thick, is well exposed in an active quarry near CMA. The upper part of this formation is fine-grained limestone, claystone and calcareous greenish-gray and greenish-red shale. The lower part of the formation is light to medium gray, very fine-grained limestone. The basal zone consists of about 20 feet of multicolored shale and sandstone that unconformably overlie the Mascot Dolomite of the Knox Group (**Figure 2-3**).

2.3 Soil

U.S. Department of Agricultural (DOA), Soil Survey of Hamilton County, Tennessee (1982) describes the soil at the Station as classified as Arents, gently sloping soil group (ArB) (**Figure 2-4**). These are soils that have been disturbed, moved or deeply mixed by machinery; most have been "cut and filled". Slopes are predominantly 2 to 6 percent. Because the Arents soils have been disturbed, no interpretative grouping or "typical" soil properties data are available.

The soil immediately adjacent to the Station's southern boundary is classified as Colbert-Urban land complex (CdC) (**Figure 2-4**). The complex consists of deep, moderately well drained CdC soils with 2 to 12 percent slopes, urban land, and disturbed areas that have been altered during construction. Urban land consists of areas covered by streets, parking lots, buildings, and other structures.

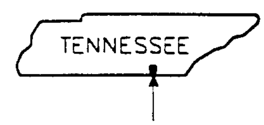
Typical CdC soils have a surface layer of brown silt loam 4 inches thick. The subsoil is yellowish brown clay that extends to a depth of 45 inches. It is mottled in shades of brown and gray in the lower 30 to 35 inches. The underlying material is light brown clay which has gray and brown

LEGEND

Qal	ALLUVIAL DEPOSITS Quaternary
Osr	STONES RIVER GROUP Middle Ordovician
Omd	MASCOT DOLOMITE Lower Ordovician
Oc	CHEPULTEPEC DOLOMITE Lower Ordovician
OCk	KNOX GROUP Late Cambrian

0 1/4 1/2 1 MILE

SCALE



QUADRANGLE LOCATION

SOURCE: THE TENESSEE DIVISION OF GEOLOGY, GEOLOGY MAP EAST CHATTANOOGA QUADRANGE, TENNEESSEE, 1989.

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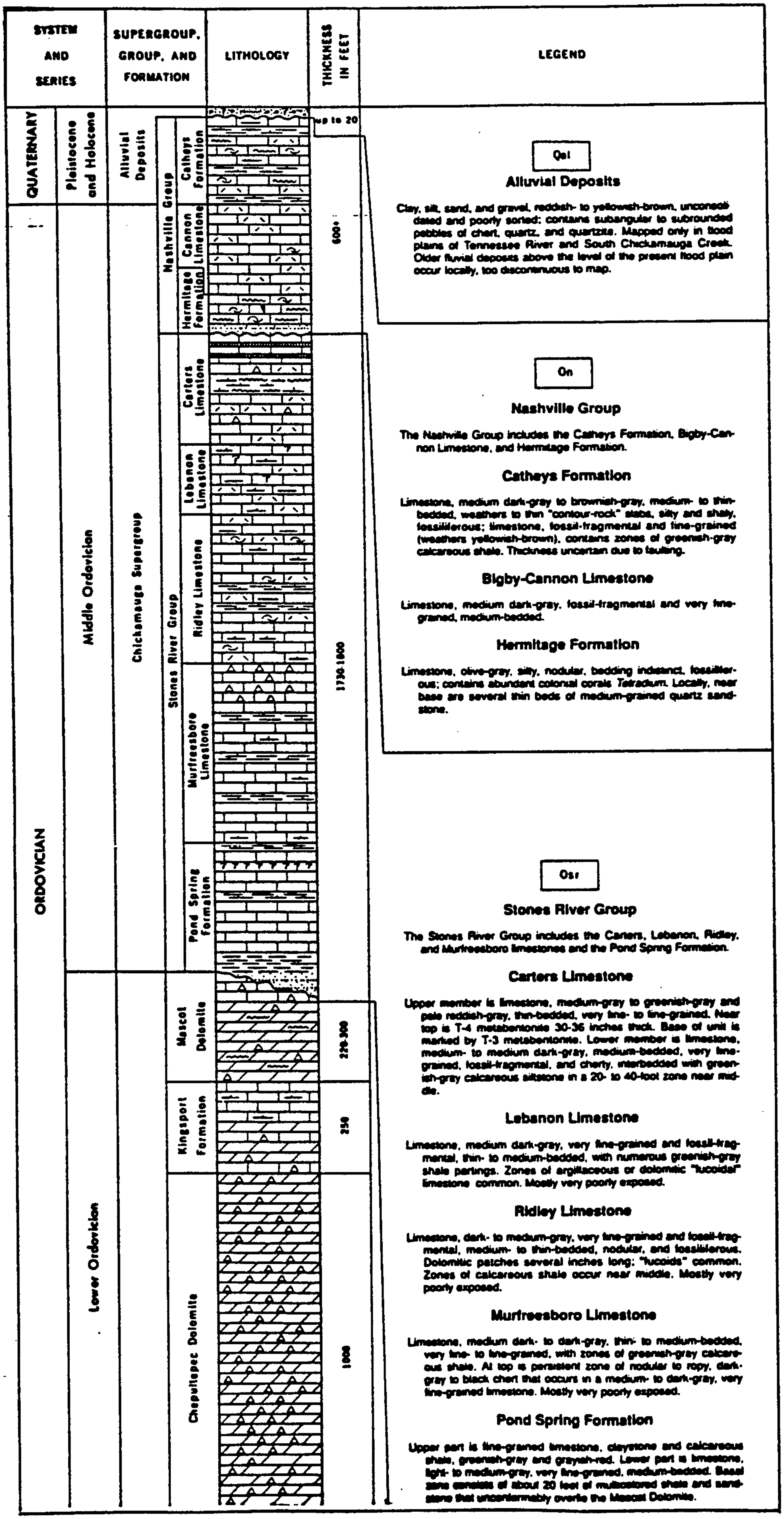
FIGURE 2-2.

GEOLOGICAL MAP FOR LOVELL FIELD ANGS AND SURROUNDING AREA 241st EIS, TENNEESSEE ANG

FIGURE 2-3 STRATIGRAPHIC COLUMM OF FORMATIONS IN THE VICINITY OF LOVELL FIELD ANGS



Source - Wilson, Geologic Map of the East Chattanooga Quadrangle, Tennessee, 1989

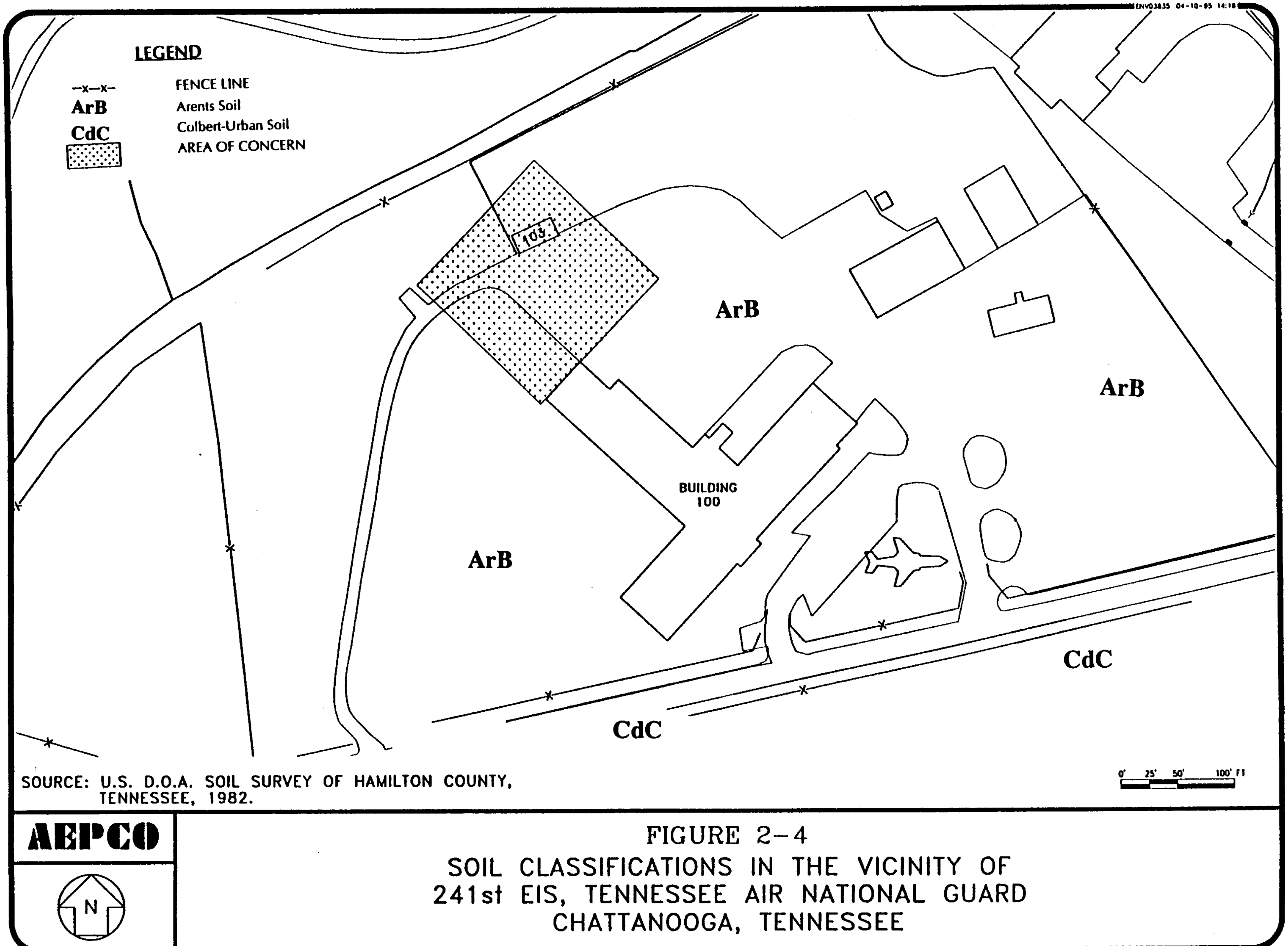


FIGURE 2-4
SOIL CLASSIFICATIONS IN THE VICINITY OF
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CHATTANOOGA, TENNESSEE

mottles. Limestone bedrock occurs between 40 to 60 inches below the ground surface. The Colbert soils have the following characteristics presented in **Table 2.2.**

Table 2.2 Typical Natural Stratigraphic Soil Characteristics

Depth (in)	USDOA class	Hydraulic Conductivity (in/hr)	pH
0 to 4	Silty Loam	0.2 to 2.0	5.1 to 5.5
4 to 55	Clay	$< 5 \times 10^{-13}$	5.1 to 5.5
55 +	Limestone Bedrock	--	--

The soil at AOC A consists of a tight cohesive clay, from the surface to 9 to 17 feet below ground surface (BGS). Weathered limestone to competent limestone bedrock occurs immediately below the clay.

2.4 Surface Water Hydrology

The Tennessee River is the main surface water feature in Hamilton County, King (1931). It enters the county in the northeast corner and flows southward toward Lookout Mountain (**Figure 2-5**). The mean annual flow rate of the River at a USGS stream gauging Station approximately 5 miles west-northwest of the Station is 35,393 cubic feet per second (cfps). About 4.85 miles north of Chattanooga (upgradient of the Station), this river is dammed by the Chickamauga Dam, forming Lake Chickamauga. The Tennessee Valley Authority (TVA) dam generates power for the south central TVA electrical grid system.

Chickamauga creek lies to the west of the Station. In the area of the Station the creek is aligned to the north/south and flows northward. This creek is perennial and along its shore exists a sewage disposal plant to the south of the Station. Chickamauga creek flows into the Tennessee River eleven miles, along its flow line, from the Station. The potential 100 year flood plain has Chickamauga creek as the source of flooding that includes the Station.

The western half of the county is drained by a series of small streams that have their headwaters on Walden Ridge. These streams have eroded deep canyons into the eastern escarpment of Walden Ridge. Northeast of the Station, Grasshopper and Wolfever Creeks are the major westward-flowing streams which have their headwaters along the slopes of Whiteoak Mountain.

Major floods have occurred over the last 130 years from headwater flows on the Tennessee River and to a lesser extent from tributary headwater flows (*King*, 1931 and TVA, 1979). In early 1936, Norris Dam was completed. This marked the inception of the TVA flood control program. This dam is located 102 miles to the north east of the Station and is located on the Powell and Clinch Rivers. Chickamauga Dam was completed on January 31, 1941. Ultimately, this program has substantially reduced the magnitude of flooding within the Chattanooga area. The ten greatest floods recorded at Chattanooga from 1867 through 1979, as described by *King* and TVA, are presented in **Table 2-3**. These occurred prior to the addition of Chickamauga Dam which has greatly reduced the severity of floods occurring past 1941. Flood stage on the Tennessee River is

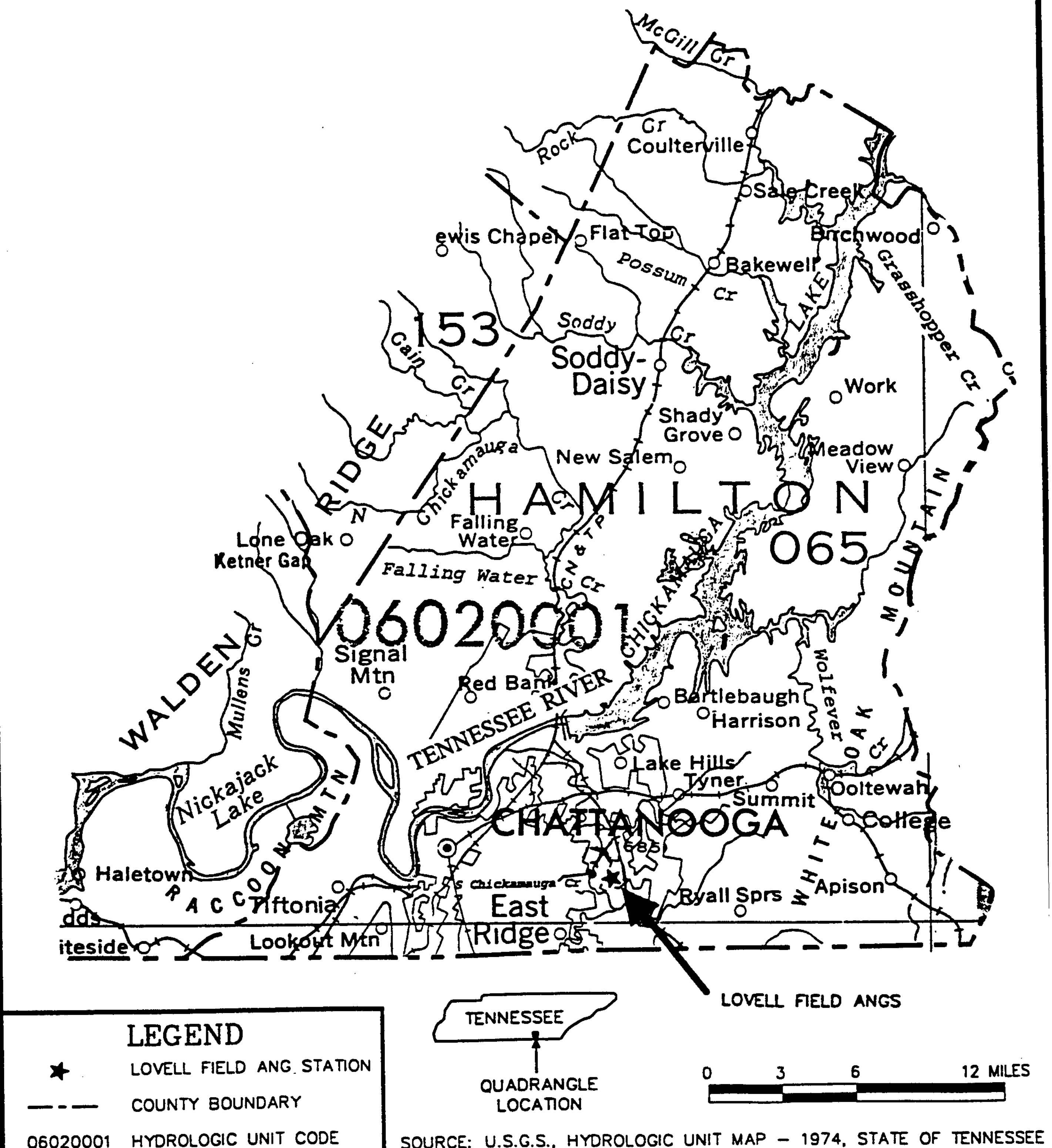

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FIGURE 2-5
MAJOR SURFACE WATER BODIES IN
HAMILTON COUNTY, TENNESSEE
241st EIS, TENNESSEE ANG

30 feet at Chattanooga. For example, a flood in March 1973, produced a flood stage of 36.9 feet at Chattanooga. It had been estimated that without TVA flood controls, the crest would have exceeded 52 feet (TVA, 1979).

TABLE 2-3 Crest Elevation of the 10 Greatest Floods at Chattanooga (1867-1979)

Order No.	Date of Crest	Gauge Height	Elevation (feet)	Chickamauga Creek Elevation (ft)[1]
1	March 11, 1867	57.9	679.0	682.4
2	March 1, 1875	53.8	674.9	678.5
3	April 3, 1886	52.2	673.3	676.8
4	March 7, 1917	47.7	668.8	671.8
5	April 5, 1920	43.6	664.7	667.9
6	March 10, 1884	42.9	664.0	667.3
7	February 1, 1918	42.7	663.8	667.1
8	March 2, 1890	42.6	663.7	667.0
9	January 2, 1902	40.8	661.9	665.5
10	April 5, 1896	40.5	661.6	665.3

[1] = feet AMSL

The projected 100-year flood plain, under present conditions, contains the Station as determined by TVA and will have flood water reaching an elevation of 672 feet AMSL. The elevation of the Station is between 666 to 671 feet AMSL. According to ANG employees at the Station, two floods have occurred over the past twenty years. AOC A (elevation 669 to 671 feet AMSL) was submerged during both of these two recent floods.

The Tennessee River is the water source for the Tennessee-American Water Company, which is the largest supplier of water for the City of Chattanooga and several adjacent communities including the Station. The intake of the water filtration plant is located 3 miles down gradient from the confluence of South Chickamauga Creek and the Tennessee River, which is approximately 14 miles down gradient of the Station.

2.5 Hydrogeology

Groundwater in Hamilton County, Tennessee, occurs in both surface unconsolidated deposits, consolidated sediments and underlying bedrock (*DeBuchananne* and *Richardson*, 1956). Regional groundwater flow, in the unconfined aquifer is toward the west and in the confined aquifer is toward the northeast in the area surrounding the Station. The confined Cambrian-Ordovician Carbonate Aquifer (COCA) is the most utilized in the region for domestic and industrial uses. This confined aquifer is listed as the "Best aquifer in the County" *(Geology of Hamilton County, Tennessee, Tennessee Division of Geology, 1979*). A total of 416 springs

emanate from the Knox group COCA in the region with 86 averaging more than 450 gpm and 82 ranging between 100 to 450 gpm. The wide spread nature of the springs indicates the confined aquifer is a good aquifer (*DeBuchananne* and *Richardson*, 1956). Hardness is the most objectionable characteristic of the COCA. No other rock unit regionally was identified as a good potential aquifer and this leaves the confined COCA as the primary sole groundwater source for the Chattanooga area (**Figure 2-6**).

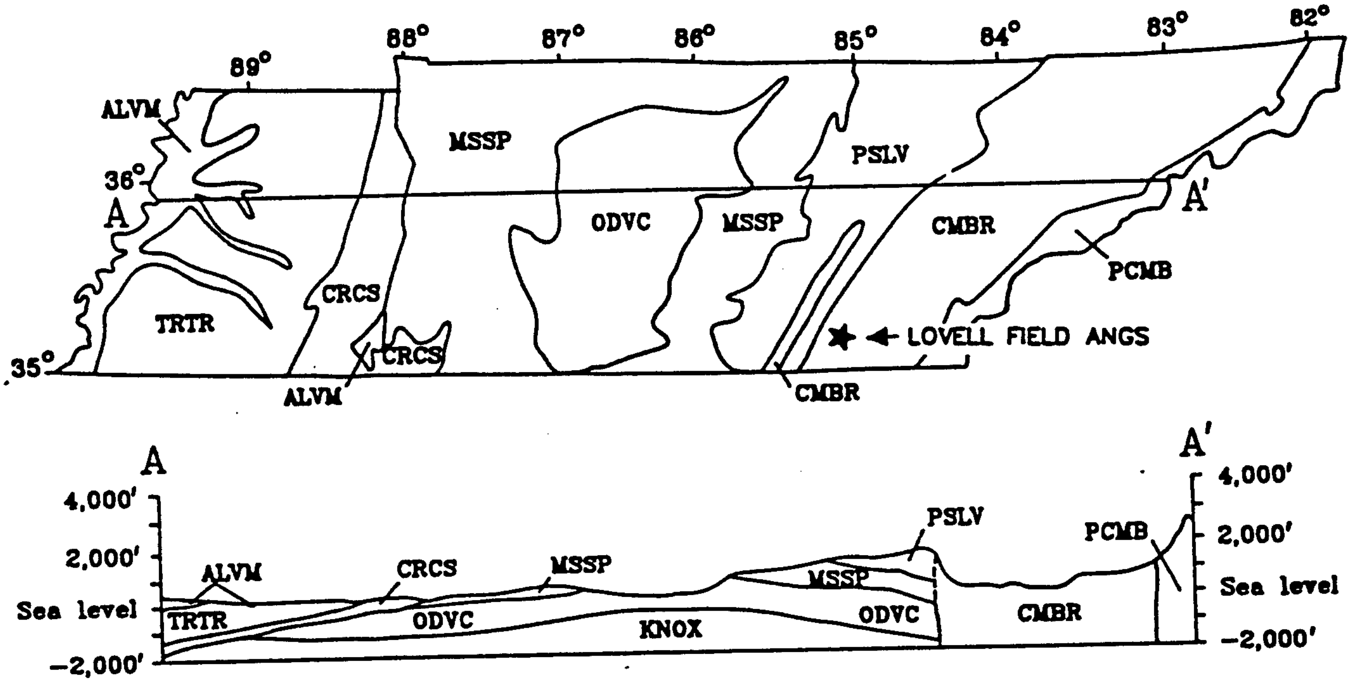
Consolidated sediments (shale, sandstone, limestone and dolomite) have quite variable water-bearing properties. Shale has a very low permeability unless secondary openings such as fracturing are present. Most shale deposits in Hamilton County are poor aquifers with yields of less than 5 gallons per minute (gpm).

The amount of water produced by wells in Knox group limestone or dolomite is dependent on the number and size of solution cavities encountered in drilling. These cavities are most abundant in the first 250 feet. Regionally wells that exist near perennial streams have yields up to 100 gpm, but wells not located near streams occasionally yield large quantities of groundwater.

Figure 2-7 presents the numerous well locations surveyed by the Tennessee Division of Geology (TDG) (*DeBuchananne* and *Richardson,* 1956) in the vicinity of the Station and also several well locations from the records of the TDEC. According to TDEC, there are 33 wells with records (as of November 1993) in the USGS quadrangle containing the Station (the East-Chattanooga quad).

The average water yield for the 24 wells with yield data is 34 gpm. The average static groundwater level for the 16 wells with available data is 32 feet. One of the closest wells to the Station (well W-A, **Figure 2-7**) near the intersection of Highway 11-64 and East Brained Road (about 1.3 miles southwest of the Station), has a yield of 40 gpm. The top of the aquifer, or water bearing zone, is reported to be 79 feet below the ground surface. Another well (well 108, **Figure 2-7**), near the intersection of Shallowford Road and Highway 153 (1.6 miles northeast of the Station) had a yield of 20 gpm with a groundwater level of 20 feet below ground (ground elevation is 660 feet AMSL, DeBuchananne, 1956). Because the majority of the residents in the East-Chattanooga Quadrangle are served with City water, only 4 out of the 33 wells are residential (wells W-B,W-C,W-D,W-E, **Figure 2-7**). The closest of the residential wells is W-B which lies 2.5 miles to the east of the Station.

The regional unconfined aquifer exists in the unconsolidated surface deposits and has it's most productive yielding zones at the contact base with the bedrock. The unconsolidated surface deposits include alluvium, colluvium, and residuum. Alluvium is found in the flood plains of creeks and rivers and is composed mainly of clay, silt, and scattered rock fragments. The average thickness is 3 to 6 feet, but these deposits may reach 20 feet in depth. Colluvium is locally much thicker than alluvium, but confined to the steeper slopes of the mountains in the Chattanooga area (e.g., Walden Ridge and Whiteoak Mountain). The colluvium consists of clay, sand, silt and rock fragments. Both alluvium and colluvium have a rather low water yield. Residuum, the thickest and most extensive unconsolidated depositional material in Hamilton County, overlies the limestone and dolomite of the area. Its thickness may range from a few feet to over 150 feet. Residuum, where it overlies limestone, is composed mainly of a very cohesive clay, and typically



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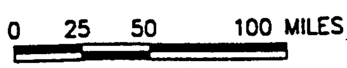
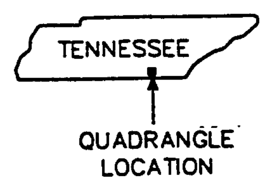
ALVM	ALLUVIAL AQUIFER
TRTR	TERTIARY SAND AQUIFER
CRCS	CRETACEOUS SAND AQUIFER
PSLV	PENNSYLVANIAN SANDSTONE AQUIFER
MSSP	MISSISSIPPIAN CARBONATE AQUIFER
ODVC	ORDOVICIAN CARBONATE AQUIFER
KNOX	KNOX AQUIFER
CMBR	CAMBRIAN–ORDOVICIAN CARBONATE AQUIFER
PCMB	CRYSTALLINE ROCK AQUIFER
A–A'	TRACE OF CROSS SECTION
★	LOVELL FIELD ANGS





SOURCE: U.S.G.S., ESTIMATED USE OF WATER IN TENNESSEE, 1985.

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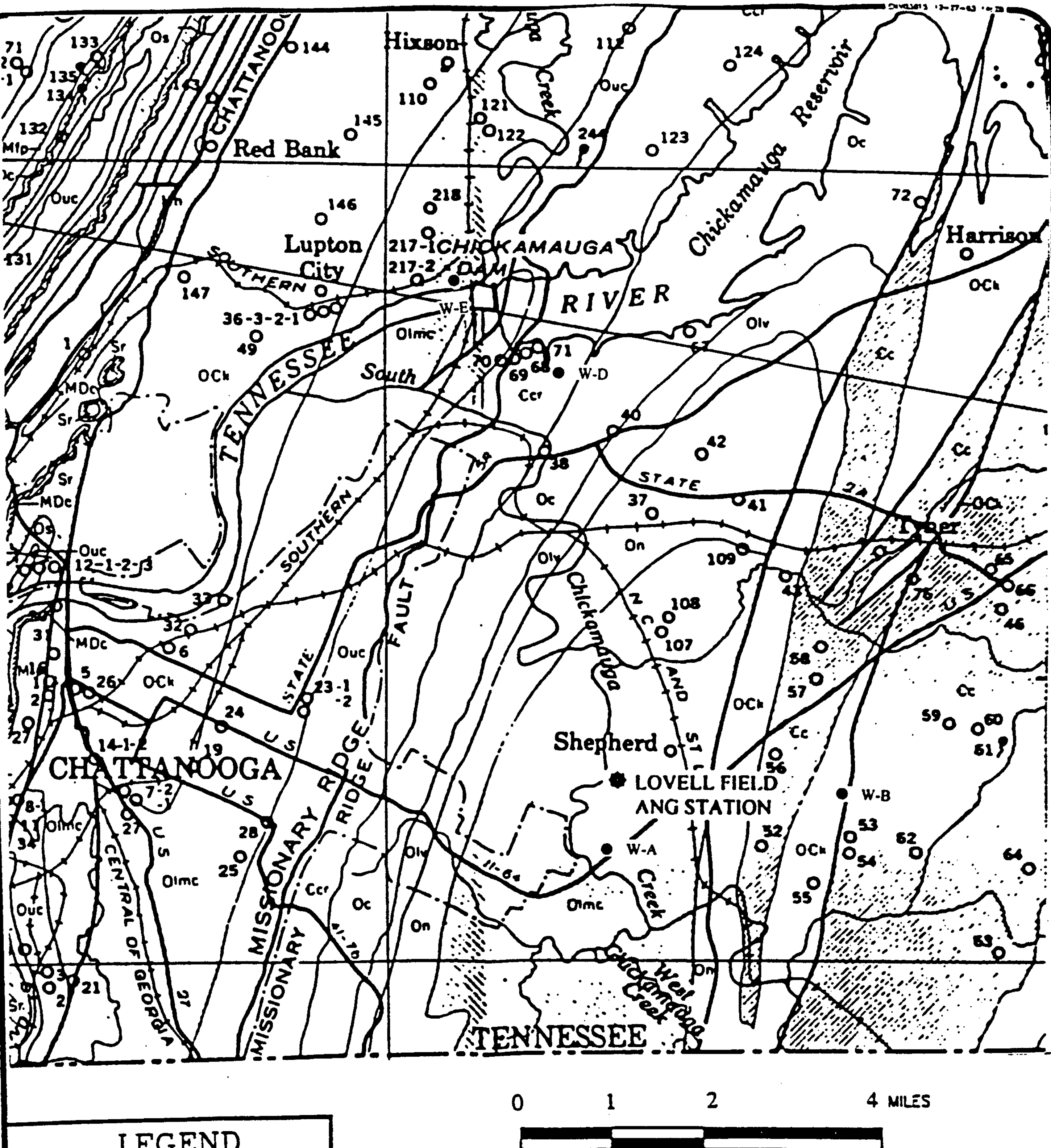
FIGURE 2-6

PRINCIPAL GROUP WATER AQUIFERS IN TENNESSEE

241st EIS, TENNESSEE ANG



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★ LOVELL FIELD ANGS
○ WELL LOCATION (BY TDG)
⊙ WELL LOCATION (BY TDEC)

SOURCE:
1. TN. DEPT. OF ENVIRONMENT AND CONSEVATION. RECORDS OF WATER WELLS IN TENNESSEE. 1993.
2. TN. DIVISION OF GEOLOGY. GROUND-WATER RESOURCES OF EAST TENNESSEE. 1956.

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FIGURE 2-7
LOCATION OF GROUND WATER WELLS NEAR LOVELL FIELD, 241st EIS, TENNESSEE ANG CHATTANOOGA, TENNESSEE

has a very low hydraulic conductivity and low water yield. Cracking of the native clay soil results from it's cohesiveness and to the weathering of the underlying limestone. This process becomes pronounced over a long period. The residual clays at the Station are not native, they have been remolded as a result of cut and fill operations associated with the construction of the Airport. The regional residuum is not homogeneous in that it may contains larger angular fragments, and normally will yield water sufficient for most domestic purposes *(Geology of Hamilton County, Tennessee, Tennessee Division of Geology, 1979*). Use of the unconsolidated aquifer is limited and the most utilized aquifer is the COCA that exists within the Knox Group Limestone bedrock.

2.6 Rare and Endangered Species and Habitats

The Station area contains no endangered species or habitats. Within the region documented occurrences of the Snail Darter are located on Chickamauga Creek within 1.5 miles north of the Station. Chickamauga Crayfish, Yellow-Crowned Night-Heron, Southern Nodding Trillium, and Lance-Leaf Trillium occur in regions from 0.5 miles to 2 miles south of the Station, along the Chickamauga Creek. The following **Table 2-4** gives the species name and common name of these endangered species.

TABLE 2-4 RARE AND ENDANGERED SPECIES

COMMON NAME	SPECIES NAME
Snail Darter	*Percina Tanasi*
Chickamauga Crayfish	*Cambarus Extraneus*
Yellow-Crowned Night-Heron	*Nyctanassa Violacea*
Southern Nodding Trillium	*Trillium Rugellii*
Lance-Leaf Trillium	*Trillium Lancifolium*

3.0 FIELD INVESTIGATIONS METHOD

This section describes the PA/SI activities completed at the Station to characterize AOC A. The primary purpose of this investigation was to confirm the presence or absence of organic/inorganic contaminants in the soil beneath AOC A that may have resulted from past activities; and to characterize groundwater at the Station.

The environmental media investigated during the PA/SI included groundwater, surface and subsurface soil (AEPCO WP, August 1994). Groundwater sample sets from three piezometers (PZ-1 through PZ-3) were obtained with each set consisting of VOCs, TPH, metals and cyanide analyses. Eight surface soil screening samples (SS-1 and SS-3 through SS-9) were collected and screened onsite for petroleum hydrocarbons to determine the need for additional borings (WP, AEPCO, 1994). Three surface soil samples (SB-2, SB-3 and SB-4) were taken from the five soil borings and each sample included VOCs, TPH and metals analyses. Eight subsurface soil sample sets were performed (from SB-1 through SB-5) with the set consisting of VOCs, TPH and metals analyses. One surface soil sample at a field screening location (SS-2) was also obtained for the VOC, TPH and metals analysis. Summaries of these soil and groundwater samples collected and analytical analyses performed are presented in **Table 3.1**. All soil samples were screened on site with a photoionization detector (PID). No additional samples, as described in the WP, were taken because all samples screened by the PID registered readings less than ten times the background concentrations.

The presence of surface water (at SS-2) and extensive gravel fill in two planned soil boring samples (surface and subsurface 4 to 6 foot samples from SB-1 and SB-5) resulted in the elimination of a total of five sample sets (WP, AEPCO, 1994) (see the field change request forms **LF-1**, **LF-4**, and **LF-9** in **Appendix A**).

3.1 Geology

The geological information gathered from the Station was derived from soil borings installed in AOC A and piezometers (PZ-1 through PZ-3) installations. In general, split spoon samples were taken every 5 feet during the drilling of soil borings and piezometer boreholes to characterize the strata and to assist in lithologic correlation across the Station. During air-rotary drilling, samples of the drill cuttings were observed periodically to assess the strata/bedrock texture, color and granularity.

3.2 Soil

Soil and site specific hydrology at the Station were investigated by installing five soil borings (**Figure 3-1**) at AOC A and three piezometers placed around the Station. Soil samples were taken during the drilling operation and were analyzed by using the Unified Soil Classification System (USCS). Surface and subsurface soil samples were generally collected every 5 feet or as directed by the field operations leader (FOL) using a decontaminated hardened steel split spoon (**LF-2** in **Appendix A**) according to American Society for Testing and Materials (ASTM) Method D-1586-84.

TABLE 3.1
Soil/Groundwater Sampling at the Station

Parameter	Quantity per Sample	Actual Samples	Analytical Method
VOCs			
Surface [3]	1 Brass Tube	3	SW-8010
Subsurface [3]	1 Brass Tube	8	SW-8010
Surface [2]	1 Brass Tube	1	SW-8010
Groundwater [1]	2 (40 ml) each	3	SW-8240
TPH			
Surface [3]	1 (8 oz.) each	3	California Mod. 8015
Subsurface [3]	1 (8 oz.) each	8	California Mod. 8015
Surface [2]	1 (8 oz.) each	1	California Mod. 8015
Surface [2]	1 (20 g) each	8	Immunoassay Field Screening
Groundwater [1]	1 (1 l) each	3	California Mod. 8015
Metals			
Surface [3]	1 (8 oz.) each	3	SW-7060
Subsurface [3]	1 (8 oz.) each	8	SW-7060
Surface [2]	1 (8 oz.) each	1	SW-7060
Groundwater [1]	1 (1 l) each	3	SW-7060
Cyanide			
Groundwater [1]	1 (1 l)	3	MCAWW 335.2

VOCs = Volatile Organic Compounds
TPH = Total Petroleum Hydrocarbons
[1] = From Station perimeter piezometers
[2] = Field screening in AOC A
[3] = AOC A soil samples

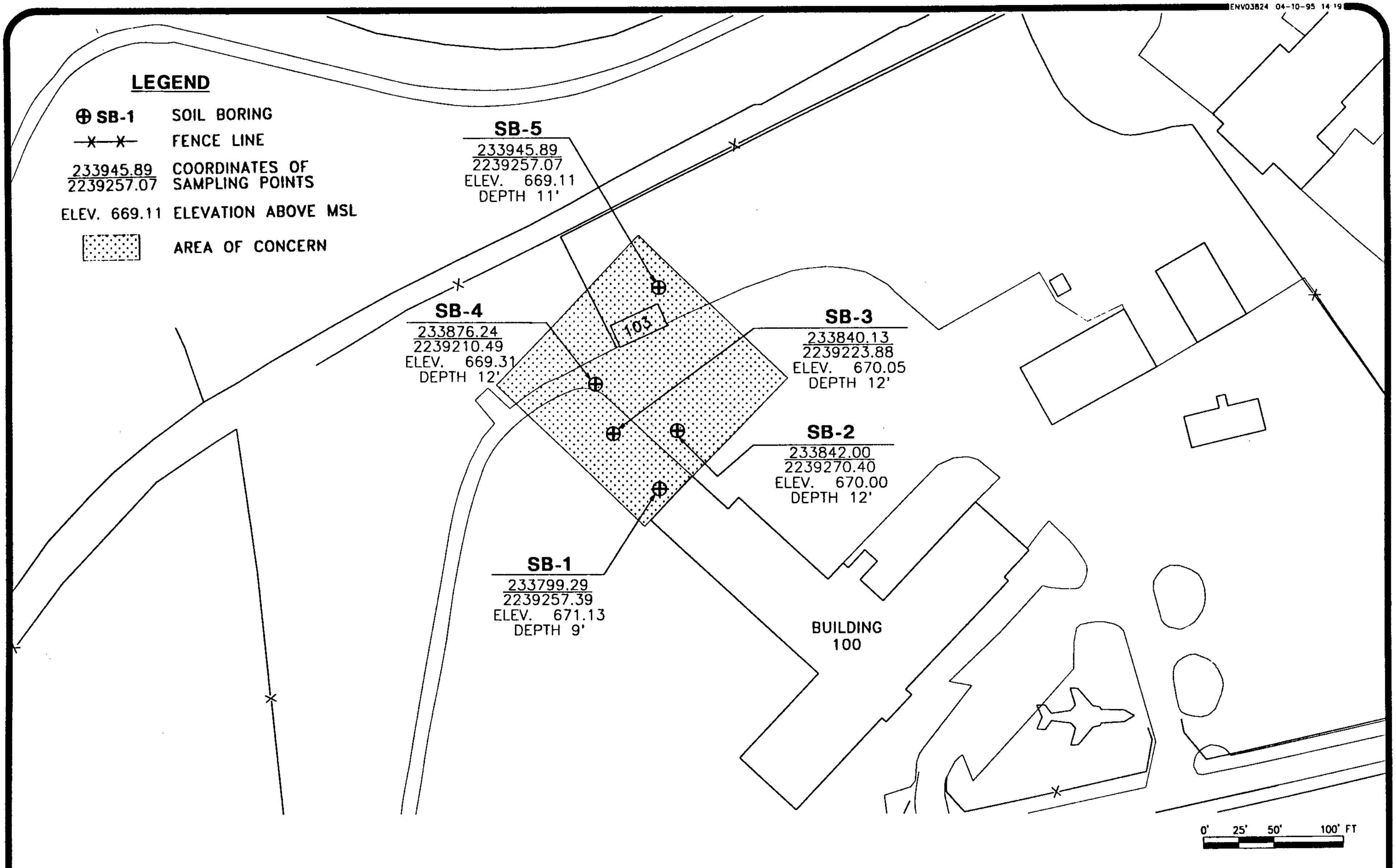

FIGURE 3–1
AOC A SOIL BORING LOCATIONS
241st EIS, TENNESSEE AIR NATIONAL GUARD
CHATTANOOGA, TENNESSEE

3.3 Surface Water Hydrology

Surface water flow from the AOC was determined by correlation with existing contour maps and the survey performed locating borings, and piezometer well surface elevations and locations. The presence of the remolded clay at the surface of most of the Station reduces the infiltration of surface water to approximately 10-20% at most. This yields an average of 20-inches/year run-off over the Station. Information from the drilling of soil boring and piezometer well boreholes indicated gravel instead of the residuum clay in AOC A down to within inches of the bedrock which acts as a short-circuit of surface water to the aquifer. The general direction of runoff from the Station is toward the drainage canal behind the Station's northern fence line as shown on **Figure 3-2**. This drainage canal flows approximately one mile and discharges into South Chickamauga Creek, which flows for another 11 miles until its confluence with the Tennessee River, approximately 2.5 miles down gradient of the Chickamauga Dam.

3.4 Hydrogeology

Hydrogeologic investigations were to:

- Determine the direction to groundwater flow; and
- Scan for the presence of groundwater contamination.

Three piezometers were installed on a facility-wide basis to accomplish these objectives (**Figure 3-3**). The initial purpose of the piezometers was to determine the direction of groundwater flow by establishing the elevation of the groundwater table at each piezometer; and to evaluate groundwater quality.

3.5 Field Contaminant Screening

For health, safety, and data collection reasons, soil borings and piezometer boreholes were monitored with a PID during drilling. In addition to the predetermined sampling intervals, if the PID readings rose higher than 10 times the background in the headspace of a borehole, a representative sample was collected at that depth. If contamination was detected, by PID screening, during the installation of a borehole for a piezometer, the borehole was to be abandoned and relocated away from the potentially contaminated areas. The headspace of the abandoned piezometer was also to be monitored with a PID prior to and during abandonment procedures.

Specifically, the monitoring was performed to:

- Identify potential health and safety problems and implement additional personal protection requirements;
- Detect subsurface "hot spots" of volatile organics for sampling purposes; and
- Modify PA/SI activities and approaches, when necessary.

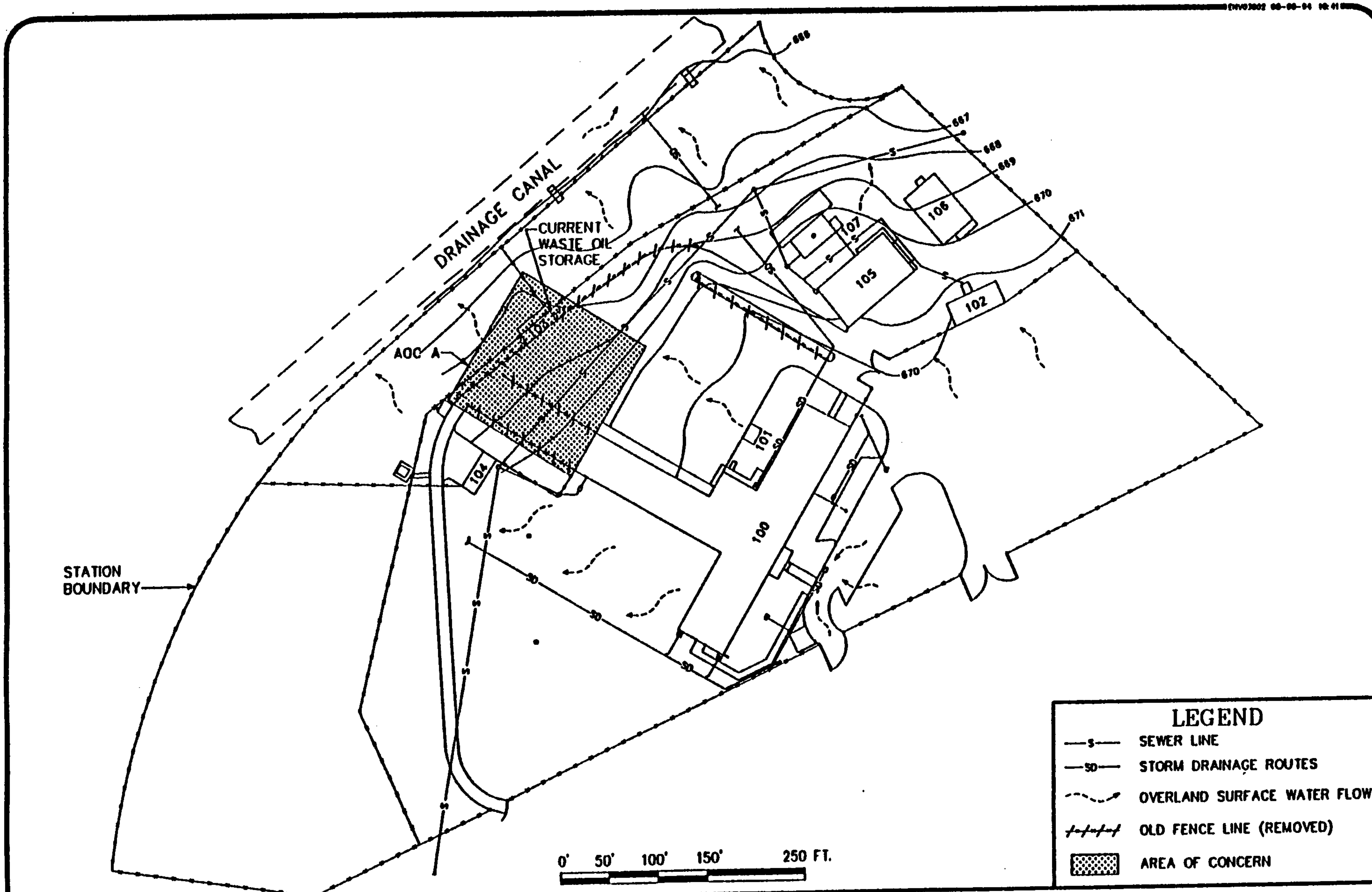

FIGURE 3-2
SURFACE DRAINAGE PATTERNS AT THE STATION
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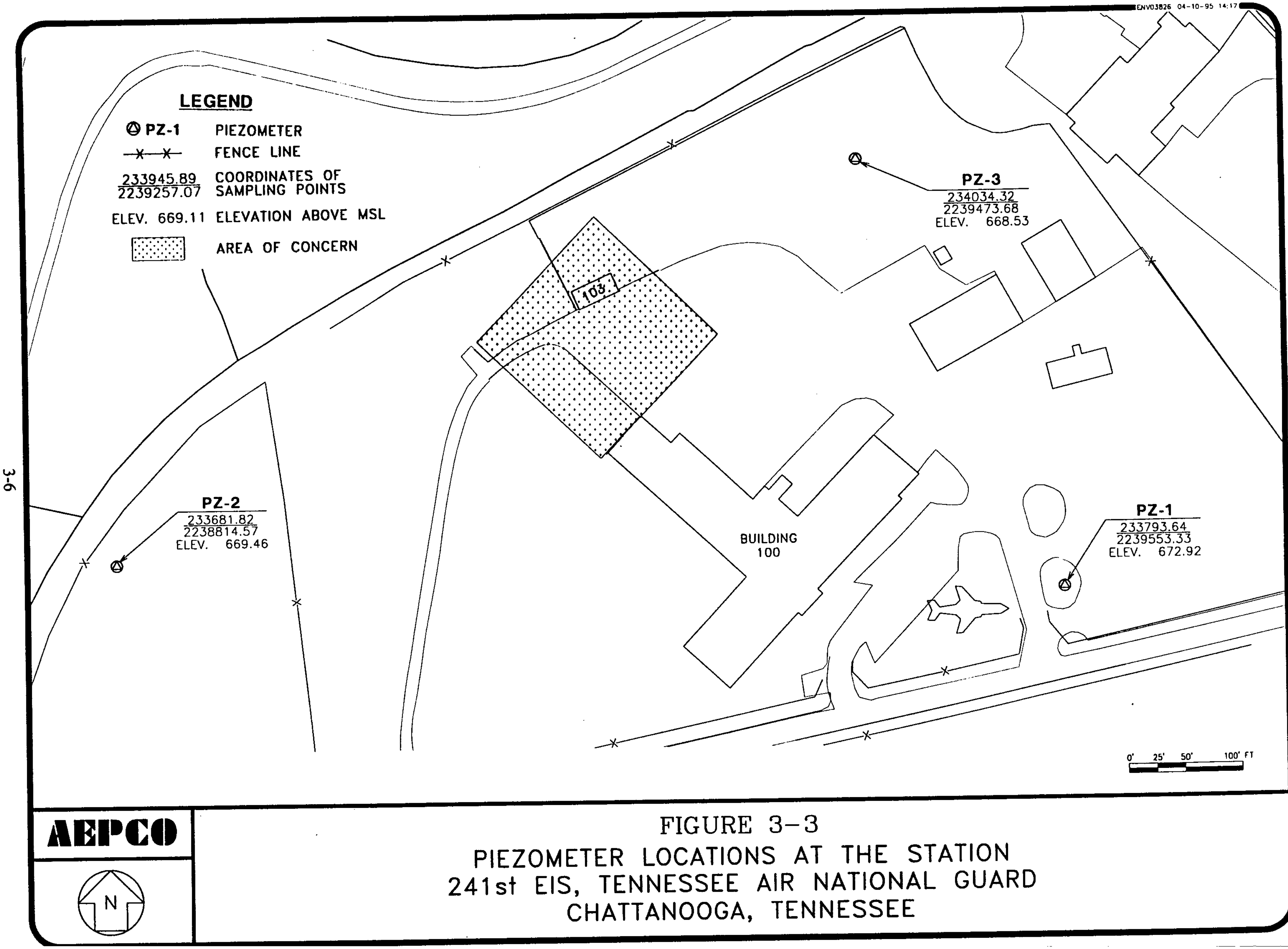

FIGURE 3-3
PIEZOMETER LOCATIONS AT THE STATION
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During the Site Inspection, no PID readings exceeded 2 times the background, so no additional samples were taken. Likewise, no planned piezometer well locations were abandoned.

3.6 Confirmation and Delineation Activities

To confirm or exclude the presence of contamination at AOC A, confirmation and delineation sampling activities were undertaken. These activities included field screening, drilling soil borings, and sampling of surface and subsurface soils. Field screening activities performed at AOC A are summarized in **Section 3.6.1**. Drilling and soil sampling procedures are outlined in **Sections 3.6.2** and **3.7.1**, and decontamination procedures utilized during the PA/SI are presented in **Section 3.6.4**. **Sections 3.6.2** and **3.7.2** outline the piezometer well installation and groundwater sampling procedures. The project manager (PM) and FOL were responsible for ensuring that sample collection and decontamination procedures were followed by all team members.

3.6.1 Field Soil TPH Screening

A total of nine surface soil samples (see **Figure 3-4**) were screened onsite for TPH utilizing the EnSys™ bioassay testing equipment and procedure.

The area of AOC A (150'x150') was equally divided into 9 grids, 50'x50' each. Surface soil was collected at the center of each grid was screened for TPH. If existing surface obstructions prevented collection of the sample at the center of the grid, the sample was collected as close as possible to the center part of the grid. This occurred on SS-7, which was moved away from under a truck, and SS-4 and SS-5 which existed in the roadway and gravel respectively, to more advantageous sampling points. If a "hot spot" (i.e. TPH concentration greater than 100 ppm) had been identified during this screening, an additional soil boring would have been installed in that sampling location to collect near surface and subsurface soil samples for laboratory analysis.

This immunoassay technique relies on a molecule, referred to as an antibody, that has a high degree of affinity for the target analyte (e.g., TPH). The high specificity and high affinity of the antibody is coupled with a sensitive colorimetric reaction that provides visualization of the result. This chemistry is accomplished with a small amount of solutions that is applied to the processed sample or a dilution thereof. Soil sampling requires a simple extraction step and subsequent filtration of the extract.

The immunoassay-based screening was used as a tool to determine if additional soil borings should be installed, and if so, where they should be installed. Specific components of this test were set to detect TPH in soil at concentrations greater than 15 ppm and greater than 100 ppm. Eight samples received immunoassay-based screening and two were found to contain over 15 ppm and less than 100 ppm, and the other 6 resulted in less than 15 ppm.

3.6.2 Soil Boring Installation

Surface and subsurface soils samples from 5 soil borings were collected in AOC A for laboratory analysis (**Figure 3-4**). Soil boreholes were drilled with a 6.25-inch out-side diameter (OD) hollow

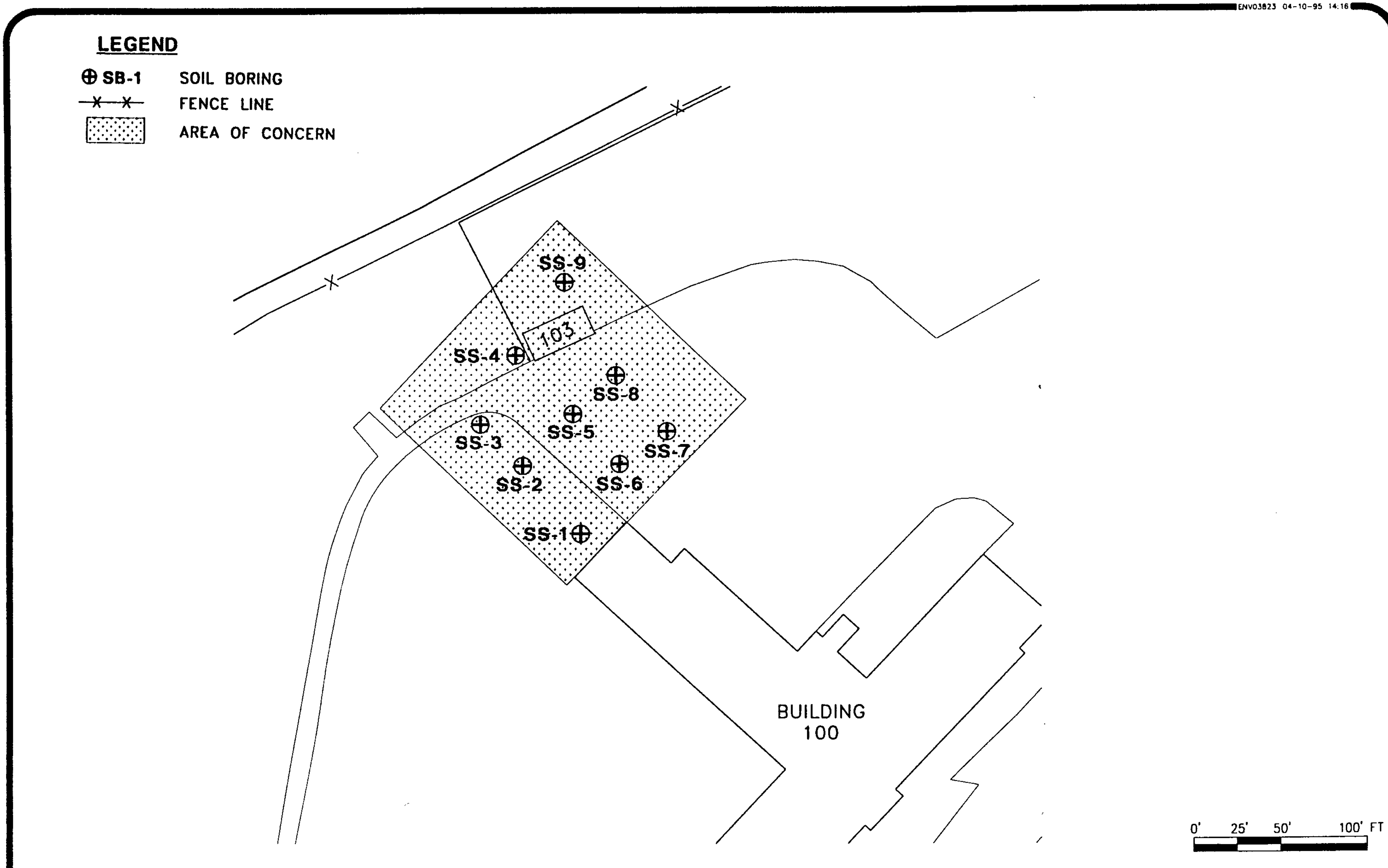

FIGURE 3-4
AOC A SURFACE SOIL SCREENING LOCATIONS
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stem auger and samples were collected (**Section 3.2**) for laboratory analysis in order to characterize the geology/hydrogeology and detection of contamination at generally 0 to 2, 4 to 6 and 9 to 11 foot intervals or as directed by the FOL. The sampling operation used split spoon (2-inch OD) sampling equipment with brass liners for collection of VOC, metals and TPH samples.

The sampling method, standard penetration testing, and split spoon sampling conformed to ASTM D1586-84. Continuous monitoring of the ambient air in the borehole headspace was performed during drilling operations. If screening resulted in PID headspace readings of greater than 10 times background, additional representative soil samples would have been collected. No PID readings exceeded 2 times the background during the PA/SI activities. More specific soil sampling procedures are given in **Section 3.7.1**.

3.6.2.1 Soil Boring Abandonment Procedure

All soil boreholes created for sampling activities were backfilled to meet TDEC requirements with portland cement containing 3% bentonite grout.

3.6.3 Piezometer Installation

Piezometers were installed around the Station perimeter to assist in defining the local groundwater flow direction and to obtain groundwater samples for laboratory analyses. The installation of the piezometers and sampling interval is given in the following.

<u>Piezometer Installation</u>

Hollow-stem augering, air-rotary drilling, and piezometer installation were performed as follows:

1. Drilled borehole with a 4.0-inch inside diameter (ID) continuous-flight hollow-stem auger and collected representative split spoon samples at 5-foot intervals or as directed by the FOL. Soil sampling equipment was cleaned with a brush and wiped off any retained soil. Where hollow stem augering encountered refusal prior to the required depth, the use of air-rotary equipment was utilized to achieve the desired depth. Air-rotary drilling produced a 5.88-inch ID borehole, allowing 1.7-inches clearance around the piezometer casing in the air-rotary bored region. During air-rotary drilling no split spoon samples were possible, so visual monitoring of the cuttings produced indications of the bedrock. During drilling, the headspace of the borehole and auger cuttings were monitored/screened using a PID. Piezometers were located in finished areas, so the cuttings were containerized in labeled Department of Transportation (DOT)-approved 55-gallon drums and placed in a central location for storage onsite and possible disposal onsite. After determination of contamination, proper disposal procedures will be performed.

   Geologic logging via split spoon sampling was performed by the AEPCO field geologist at 5-foot intervals or as directed by the FOL (e.g. the boring of PZ-3

encountered 6 feet of gravel and bedrock at 13 feet so samples were taken at 6 to 8, 10 to 12 and 13 to 15 feet). Upon encountering the water table, the borehole was advanced another 10 feet in order to ensure that the screened interval of the piezometer was in the saturated zone at all times of the year.

2. Two-inch diameter Schedule 40 polyvinyl chloride (PVC) threaded flush jointed casing and a 5-foot PVC screen with 0.010-inch slot openings and a bottom cap were used for the piezometers. No electric welding, taping, gluing, or solvent-welding of piezometer components was allowed.

3. The screen and casing were gradually lowered into the borehole. The casing pipe riser was placed in the borehole with sufficient length to reach the ground surface. The space surrounding the casing was then backfilled with the sand filter pack (chemically inert clean quartz sand and well-graded between No. 20 and No. 40 U.S. standard sieve) to a minimum of 2 feet above the top of the piezometer screen. During all backfilling operations, the auger was withdrawn in small increments in order to avoid disturbing the sand pack but without exposing the sides of the borehole above the sand pack.

   While the casing was centered in the borehole, an impervious plug of hydrated, natural bentonite (without synthetic additives) was placed as an annular seal around the casing to a point at least 2 feet above the sand pack. After the placement of the bentonite seal, the bentonite was allowed to hydrate for a minimum of eight hours before work continued on the piezometer installation. The annular space between the casing and the borehole was tremie-grouted with a portland cement-bentonite mixture from the bottom upward until 3 feet below the ground surface was reached. The cement-bentonite grout consisted of portland cement (ASTM C150) and clean tap water (not more than 7 gallons of water per bag of cement) and 3% by weight bentonite powder. The remainder of the annular space was filled with concrete until the concrete overflowed onto the ground surface. At no time was the borehole unsupported by either the auger, piezometer casing, or backfilling materials.

   The vertical and horizontal alignment of the piezometer was verified by observation. There was no need to utilize a pipe slide test to detect passing freely in the piezometer.

4. Piezometers were completed as flush mounted, as shown in **Figure 3-5**, in order to avoid disrupting Station activities. The casing was cut 2 to 3-inches below ground surface and capped with a lockable cap to prevent introduction of foreign material (LF-7, Appendix A). A protective waterproof lid, to prevent infiltration of surface water, was cemented in place around the casing top. A concrete pad was set around the protective lid to below frost depth. The protective lid was composed of an aluminum valve box assembly centered in a concrete pad with a radius of 2 to 3 feet sloping away from the piezometer (LF-8, Appendix A). The bottom of the

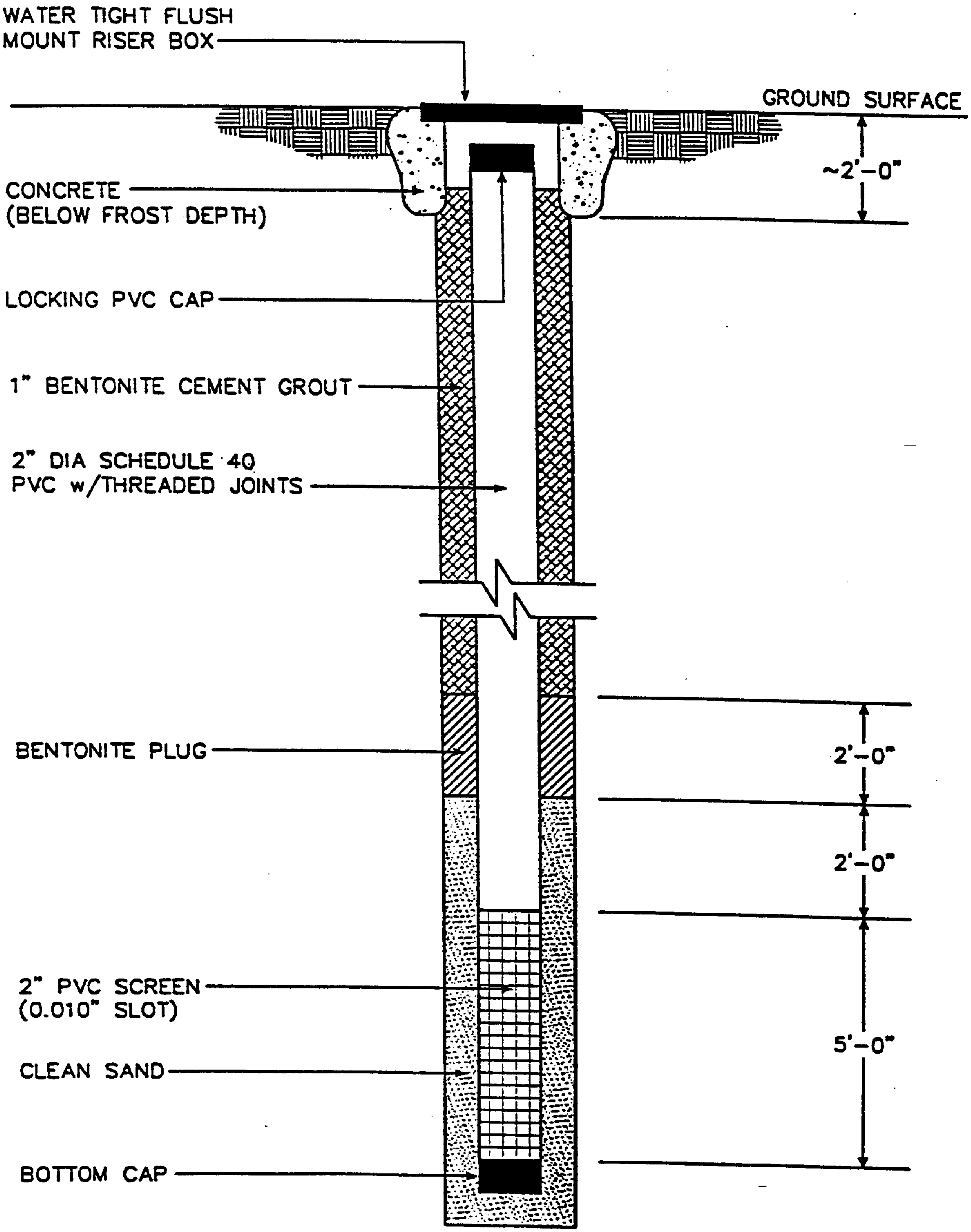

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FIGURE 3-5
PIEZOMETER AS BUILT
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valve box extended 1 foot below the top of the PVC casing. The piezometer number was clearly marked on the valve box lid, along with the screen length, total depth of the piezometer, and date installed. In addition, an aluminum plate was placed in the concrete pad as an elevation measuring point.

3.6.3.1 Piezometer Development

Piezometer development was completed by bailing and was started within 24 hours of piezometer installation and completion. The piezometers had extremely slow recharge and required a change in the sampling procedure (see **Section 3.7.2**). Piezometers were developed by bailing the piezometers dry and allowing the groundwater to recharge in the piezometer. Groundwater temperature, pH, and specific conductance were monitored periodically during piezometer development and recorded in the field log book. Turbidity measurements on all the piezometers were not possible due to the suspended silt/clay in the groundwater. Development was considered complete when the piezometers were repeatedly bailed dry over a period of 70 hours. If any water was introduced into the borehole during drilling, at least an equal amount was removed during development (PZ-3 had 5 gallons of water added to it during drilling to reduce the dust). The volume of water removed during development was recorded in the field log book, as well as the total development time. All water removed from the piezometer during development was containerized in DOT-approved 55-gallon drums, segregated, labeled by piezometer, and disposed of based on the analytical results of groundwater samples from the piezometers.

All equipment used for development was decontaminated using the procedures described in **Section 3.6.4**.

3.6.3.2 Piezometer Abandonment Procedure

One piezometer (original PZ-1) was abandoned due to construction difficulties. The abandoned piezometer was grouted by tremming grout in the interior of the piezometer casing. Once the grout level rose to a few feet below the surface, the piezometer casing was unscrewed and removed with the annulus. The remaining interior of well casing was grouted with a tremie hose. This procedure met TDEC requirements for using portland cement containing 3% bentonite grout.

3.6.4 General Decontamination Procedures

All equipment that came in contact with potentially contaminated soil or water was cleaned, as necessary, prior to each use. Decontamination consisted of either steam cleaning and/or washing with nonphosphate, laboratory-grade detergent, followed by a tap water rinse, an isopropanol rinse, and a double distilled or deionized analyte-free water (i.e., ASTM Type II) rinse. Specific equipment was decontaminated by following the procedures described in **Sections 3.6.4.1** through **3.6.4.3**.

3.6.4.1 Drilling Equipment

The drilling rig and all tools and equipment were inspected for any sign of possible source of cross-contamination (i.e. leaking hydraulic fluid, rust, etc.). They were thoroughly cleaned and decontaminated prior to initiating work at the Station. Initial cleaning of the drilling rig consisted of steam cleaning with a high-pressure steam cleaner. The drilling rig was decontaminated before moving to each site and between boreholes. In addition, all downhole equipment was washed and decontaminated before each use. The decontamination procedure consisted of steam cleaning with a high-pressure steam cleaner and/or washing with nonphosphate, laboratory-grade detergent, followed by a tap water rinse, an isopropanol alcohol rinse, and a double distilled analyte-free water (i.e., ASTM Type II) rinse. If necessary, the decontaminated drilling equipment, well casings, and well screens were protected from the elements with plastic sheeting. Finally, the drilling rig and all drilling tools were decontaminated upon completion of the drilling work to ensure that contaminated materials were not transported beyond the Station boundary.

3.6.4.2 Sampling Equipment

The goal of decontamination was to avoid introducing contamination into the analytical samples (i.e., cross-contamination) or introducing contamination from one area to another. All tools used for soil sampling, including split-spoon samplers, sample-cutting knives, stainless steel spoons and bowls, etc., were decontaminated before each use by nonphosphate detergent wash followed by a tap water rinse, an isopropanol rinse, and a double distilled or deionized analyte free water rinse followed by air drying. The isopropanol and double distilled or deionized analyte-free water were pesticide grade or better. In case air drying was inefficient, an additional isopropanol rinse was added to help dry the equipment. Sampling equipment that was not immediately reused was wrapped in aluminum foil (shiny side out) for protection against fugitive dust and/or vapors.

For groundwater sampling, Teflon bailers were utilized. Bailers were decontaminated before each use by washing with nonphosphate, laboratory-grade detergent, followed by a tap water rinse, an isopropanol rinse, and a double distilled or deionized analyte-free water rinse. Sampling equipment that was not immediately reused was wrapped in aluminum foil (shiny side out) for protection against fugitive dust and/or vapors. A new piece of nylon was used as the hoisting line at the piezometer. This line was discarded after use.

3.6.4.3 Sample Containers

Sample containers were purchased through the contracted analytical laboratory. They were precleaned (decontaminated) to meet or exceed all US EPA Contract Laboratory Program container guidelines. **Table 3-2** presents the sample containers, preservatives, and holding criteria observed during the SI.

Table 3-2 Sample Containers and Sample Preservation

Parameter	Container	Holding Time	Preservative
Volatile Organics			
Soil	brass liner	14 days; < 24 hr on site	4° C
Groundwater	40 ml vials	14 days; < 24 hr on site	HCl to pH < 2
TPH			
Soil	8 oz. WMJ glass	Extract 14 days; 40 days	4° C
Groundwater	1 l A glass	28 days	HCl to pH < 2
Metals			
Soil	8 oz. WMJ glass	38 days	4° C
Groundwater	1 l PE bottle	6 months; 13 days for Hg	HNO_3 to pH < 2

A = Amber

WMJ = Wide Mouth Jar

PE = Polyethylene

3.7 Sampling

Environmental media that was sampled at the Station consisted of soil and groundwater. Contaminant analyses included VOC, TPH and priority-pollutant metals. Groundwater was also tested for total cyanide for Chattanooga Municipal Discharge criteria.

3.7.1 Soil Sampling

Soil samples were obtained during drilling operations from the three piezometer boreholes (see **Figure 3-1**) and from the five soil borings installed in AOC A (see **Figure 3-3**). Grab samples were collected at the Station by using a decontaminated hardened steel split spoon (**LF-2** in **Appendix A**). No composite soil samples were collected. The designation used during the PA/SI for surface soil (0 to 2 feet) and two subsurface soil samples (5 to 7 and 10 to 12 feet) are addressed in **LF-3** in **Appendix A**. These soil samples were analyzed in the field for volatile VOCs by using a PID and then logged (i.e., recording its texture, color, consistency, moisture content, layering and other pertinent data using the USCS according to ASTM D2488-69, "Description of Soils") in the field log book. (See **Appendix C** for the geologic logs of the soil borings). The following outlines the soil sampling performed at the Station:

1. Monitored the borehole while augering with a PID. Upon removal of the auger, scanned the soil with the PID and recorded the measurements.

2. Discarded any excessively disturbed or loose material found in the sampler that was not representative of the interval sampled. This material was containerized in labeled drums with augering spoils at each augering location.

3. Performed a visual examination of the sample and recorded its texture, color, consistency, moisture content, layering and other pertinent data using the USCS according to ASTM D2488-69, "Description of Soils".

The primary goal of the soil samples taken in AOC A was to perform VOC, TPH, and metals contaminant analyses. Surface and sub-surface soil samples were collected by using a decontaminated hardened steel split spoon equipped with brass liners. These samples were collected, documented, packaged, and shipped to the designated laboratory for analysis employing the procedures outlined below:

1. Utilized decontaminated brass liners installed in the decontaminated hardened split spoon sampler for Soil samples for VOC analysis.

2. Monitored the borehole with a PID while augering. Upon removal of the split spoon from the auger, scanned the borehole and soil from the split spoon sampler with the PID and recorded the measurements.

3. Discarded any excessively disturbed or loose material found in the sampler that was not representative of the interval sampled. This material was containerized in labeled drums with augering spoils at each augering location.

4. Removed the brass liner containing the soil for VOC analysis and immediately trimmed, capped, labeled, and placed on ice inside two Ziploc™ bags which was placed in an insulated cooler. The remaining soil sample was removed from the brass liners and placed into a decontaminated stainless steel bowl/tray. A visual examination of the sample was performed and recorded.

5. Using a decontaminated stainless steel spatula, chopped and remixed the remaining soil samples to obtain a homogeneous sample for TPH and metals analyses. Soil samples were placed in appropriate containers, capped, labeled accordingly, and placed on ice in an insulated cooler.

6. Initiated chain-of-custody procedures.

7. Staked and noted the locations of all soil samples in the field log book. All soil sampling locations were tied to the Tennessee State Plane Coordinate System by the surveying subcontractor.

8. Decontaminated the sampling device using the procedures described in **Section 3.6.4.2**.

The sampler exercised care while collecting samples for contaminant analysis. The methods to ensure that quality samples were collected are described below:

1. Ensured the sample was obtained from undisturbed soil below the casing or auger. This was accomplished by monitoring or checking the drill crew's measurements, observing the sampling process, and examining the sample after retrieval.
2. Carefully removed and discarded portions of the sample that indicated contamination by casing or auger contact.
3. Conserved the sample volume because, under certain soil conditions, it may be difficult or impossible to achieve good sample recovery with split spoons.

Procedures employed to prevent cross-contamination during subsurface sampling operations included the following:

1. Samples were taken immediately after the boring was advanced to the desired sampling elevation.
2. The sampling tools were decontaminated prior to taking each sample (**Section 3.6.4.2**).
3. The drilling contractor was not permitted to use oil, grease or other petroleum-based lubricants on the drill rods, casing or sampling tools.
4. The drilling technique and procedures to be used were carefully evaluated for each borehole installation site.

When an insufficient sample volume was obtained, another soil boring was taken to obtain the soil sample immediately adjacent to the original sampling site, (i.e. within 2 feet, see **LF-5, Appendix A**). Samples were shipped in insulated containers with ice in order to keep them at 4°C. The ice was placed in two Ziploc™ bags which were placed in the cooler to preclude ice melting next to the samples. The samples were delivered as soon as possible after collection to allow the laboratory to meet holding times. In no case were samples held for more than 24 hours at the site. Shipping containers were packed with bubble-wrap to ensure that samples were not disturbed/broken during transport.

The sample custody and documentation procedures described in WP were followed during sample collection at the Station. Each person involved with sample handling was trained in chain-of-custody procedures prior to the implementation of the field program.

A chain-of-custody form accompanied all samples during shipment to the laboratory. The information provided on the Chain-of-Custody Form included:

- Project name;
- Signature of the samplers;
- Sampling Station number or sample number;
- Date and time of collection;

- Sample type (i.e., grab);
- Brief description of the type of sample and sampling location;
- Number of containers used;
- Analyses required;
- Sample matrix;
- Preservatives used;
- Signature of individuals involved in the sample transfer; and
- Time and date they receive the sample was secured by the analytical lab.

Chain-of-custody forms initiated in the field were placed in a plastic cover and taped to the inside of the shipping containers used for sample transport from the field to the laboratory.

An experienced geologist was present at the operating drill rig for the logging of samples, the monitoring of drilling operations, the recording of soil and groundwater data, the monitoring and recording of piezometer installation procedures, and the preparation of boring logs and piezometer completion diagrams.

3.7.2 Groundwater Sampling

Groundwater samples were collected from piezometers installed during this SI. Groundwater sampling activities were performed as described below. Modifications were required to accommodate a very slow recharge in PZ-1, PZ-2, and PZ-3. As stated in the WP, bailing a well dry and sampling within 24 hours is an acceptable procedure for slow recharge wells in lieu of purging three well volumes. A field change **LF-6 (Appendix A)** was instituted allowing this combination development/purging procedure and specifying the increase of metals samples.

The physical parameters that were taken for the development water included temperature, conductivity, turbidity, and pH. Testing of the physical parameters was not always possible during each purge due to the small quantity of very silty groundwater initially removed from the piezometers. PZ-2 had such a slow recharge no physical testing was possible after the groundwater sampling. During development, the groundwater never became clear enough to obtain a valid turbidity measurement, therefore, no turbidity measurements were taken. When possible the final measurement was taken immediately after sampling the groundwater for contamination. The resultant bailing of the piezometers dry lasted over a period of one day and groundwater sampling occurred within 12 hours to obtain filtered and unfiltered metals groundwater samples from each piezometer.

The following development/purging activities were accomplished using the amended purging technique:

1. Measured and recorded the height of the outer casing.
2. After removing the cap, measured and recorded the ambient and piezometer-head organic vapor levels using a PID.

3. Measured and recorded the distance between the top of the piezometer casing and the ground surface.

4. Using a decontaminated electronic water level meter, measured and recorded the static water level from the top of the piezometer and the depth to the piezometer bottom to the nearest 0.01 foot. Upon removing the water level meter, and the tape was rinsed with distilled/deionized water.

5. The piezometer was bailed dry with the groundwater being stored in 55-gallon drums. The bailer was left hanging in each piezometer and the bailing process lasted over a period of three days.

6. A groundwater sample was taken for the physical parameters when possible.

Following the development/purging procedure, sample collection commenced in the following sequence.

1. Determined the presence of floating hydrocarbons at the water surface by slowly lowering a clean, decontaminated bailer into the top of the water column. No floating products were identified or detected at the Station.

2. Lowered a decontaminated Teflon bailer to the mid-point of the static water level. Collected groundwater samples and placed them in the appropriate containers (see **Table 3-2**). Samples for VOC analysis were collected first and were filled directly from the bailer with as little agitation as possible. Other samples were placed directly into the appropriate container from the bailer.

3. Monitored the in-situ parameters (pH, temperature, and specific conductance) of groundwater if enough groundwater was present. When possible, these parameters were monitored in a beaker filled from the bailer.

4. Recorded the in-situ parameters in the Field Log Book.

5. Removed the bailer from the piezometer and decontaminated it according to the procedures outlined in **Section 3.6.4.2**.

6. Secured the locking piezometer cap.

Samples were shipped in insulated containers with ice in order to keep them at 4°C. The ice was be placed within two Ziploc™ bags which were placed in the cooler to preclude ice melting next to the samples. The samples were delivered as soon as possible after collection to allow the laboratory to meet holding times. In no case were the samples held for more than 24 hours at the site. Shipping containers were packed with vermiculite to ensure that samples were not disturbed/broken during transport.

The sample custody and documentation procedures described in this plan were followed during sample collection at the Station. Each person involved with sample handling was trained in chain-of-custody procedures prior to the implementation of the field program.

A chain-of-custody form accompanied all samples during shipment to the laboratory. The information provided on the Chain-of-Custody Form included:

- Project name;
- Signature of the samplers;
- Sampling Station number or sample number;
- Date and time of collection;
- Sample type (i.e., grab);
- Brief description of the type of sample and sampling location;
- Number of containers used;
- Analyses required;
- Sample matrix;
- Preservatives used;
- Signature of individuals involved in the sample transfer; and
- Time and date they receive the sample was received by the analytical laboratory.

Chain-of-custody forms initiated in the field were placed in a plastic cover and taped to the inside of the shipping containers used for sample transport from the field to the laboratory.

3.8 Disposal of Waste Generated During PA/SI

The waste generated during the PA/SI consisted of auger cuttings of soil from the piezometers and from the borings on AOC A. Groundwater from development was containerized as piezometer waste. All soil and development groundwater waste was placed in labeled 55-gallon DOT-approved steel drums. The labeling of the drums and contents are given in the following **Table 3.3**. The drums of waste were sealed and transported to a central location along the western perimeter fence near PZ-3 pending analysis to determine proper disposal procedure. Samples of the generated waste were taken for laboratory analysis. The results of the analysis are presented in **Section 4.1.4.3**.

Table 3.3 PA/SI Derived Wastes

SAMPLE	Contents	Quantity (# of drums)
PZ-1	Drill Cuttings PZ-1	5
PZ-2	Drill Cuttings PZ-2	2
PZ-3	Drill Cuttings PZ-3	1
SB 1 & 2	Drill Cuttings SB 1&2	1
SB 3	Drill Cuttings SB 3	1
SB 4	Drill Cuttings SB 4	1
SB 5	Drill Cuttings SB 5	1
LW-1*	Development Wastewater PZ-1	1
LW-2*	Development Wastewater PZ-2	1
LW-3*	Development Wastewater PZ-3	1
DW*	Decon Wastes	1

* analyzed for cyanide, BETX, and metals to meet Sewer Use and Industrial Wastewater Discharge Regulations, Chapter 31, City of Chattanooga Code (June 1990)

4.0 RESULTS OF FIELD INVESTIGATION

4.1 Area of Concern A

AOC A is located behind Building 100 at the Station. The area is covered mainly with gravel and is used as a parking area. Oil stains were visible on the gravel from the parked vehicles. The analytical results are presented and discussed in the following subsections.

4.1.1 Field Soil Screening

Field soil screening for TPH, utilizing the EnSys™ Immunoassay testing procedure outlined in **Section 3.6.1**, was conducted on AOC A. During sampling of the surface soil, PID readings were also taken on each location prior to sampling. SS-1 and SS-2 soil samples, consisted mainly of gravel fines, were taken under 6 to 8 inches of crushed stone. The results of the PID readings and Immunoassay are given in the following **Table 4.1**.

Table 4.1 AOC A Field Soil-Screening Results

Soil Screening Location	**Depth of Sample** (inches)	**PID ppm**	**Immunoassay TPH** (ppm)
SS-1	6	0.2	100 > TPH > 15
SS-2	8	0.2	100 > TPH > 15
SS-3	4	0	15 > TPH
SS-4	3	0	15 > TPH
SS-5	12	0	15 > TPH
SS-6	12	0	15 > TPH
SS-7		*	*
SS-8	12	0	15 > TPH
SS-9	16	0	15 > TPH

* = The location of SS-7 is in the parking lot. Upon removal of the bituminous paving, groundwater immediately seeped into the sampling location. The groundwater in SS-7 achieved a stable thickness of 4 inches and thus would not allow a suitable surface soil sample for field screening. See **LF-1, Appendix A.**

4.1.2 Confirmation and Delineation

As described in the WP (AEPCO, August 1994), site soil screening was utilized to detect unknown areas of TPH with concentrations exceeding 100 ppm. If specific "hot" areas had been found, additional soil borings and soil sampling were to be targeted in the "hot" areas.

Only two surface soil screening samples (SS-1 and SS-2) were detected with TPH concentrations greater than 15-ppm, but less than 100-ppm. The other six site screening locations had TPH concentrations less than 15-ppm. Therefore no additional soil borings were undertaken during the PA/SI activities.

A VOC, metals and TPH sample was sent to the analytical laboratory from SS-2 to confirm the TPH concentration. TPH concentration at No. 2 (SS-2) was reported at non detect with a minimum detection limit of 61 *mg/Kg* for heavy oil, can be compared to the TPH concentration at SB-1 (108 *mg/Kg*) which is separated by sixty feet in AOC A. Although the SB-1 clay

sample is from 5 to 6 feet BGS, it is under gravel which produces a short circuit for the TPH. The sample from SS-2 is from clay that existed under 1 foot of gravel. Thus both samples, SB-1 and SB-2 represent TPH concentrations of 108 and 106 *mg/Kg* respectively, in the upper clay, just below the gravel.

4.1.3 Geology and Hydrology

The geology and hydrology of the Station was investigated both through soil borings established within AOC A and piezometers located beyond the suspected area of concern, since the Air National Guard does not install monitoring wells or piezometers in known or suspected areas of concern. Five soil boring (SB-1 to SB-5) and three piezometer (PZ-1 to PZ-3) boreholes were utilized to evaluate the site-specific stratigraphy and stratification of the subsurface soils at the Station. During the initial installation of PZ-1 (10/24/94), the well was disrupted from the filter pack and was subsequently abandoned. This well has been identified as Abandoned PZ-1 in this report. A new PZ-1 was located eight feet to the west of the original PZ-1 as shown on **Figure 4.1**. PZ-1 is located above the bedrock in the weathered bedrock/clay and PZ-2 and 3 are located in the bedrock as shown in **Figure 4.2**. The Station is located in a karst bedrock structure. The information gathered from the boreholes installed on the Station is consistent with a residuum expected in a karst environment. However the shallow soils at the Station appear to have been reworked due to the inclusion of foreign material and a completely lacking stratigraphic structure. This reworking/filling was part of the early Airport grading operations in the area. Within AOC A an extensive amount of the clay has been removed and replaced with gravel ranging in size from 1 inch to > 8 inches. Cross sections (see **Figure 4-1** for the location of the sections) are shown that include the estimated bedrock/soil interface, groundwater, and areas of known gravel (**Figures 4-2** and **4-3**).

Regionally, overlying soils are a direct result of weathering of the limestone that produces a very cohesive clay. Features in hydrology that act to separate aquifers are known as an "aquitard" which typically exhibit very low hydraulic conductivity and are extensive enough to influence groundwater. The reworked residuum clay that exists from the weathering of the limestone bedrock is extensive and is essentially impermeable and, therefore, fits the description of an aquitard.

At Soil Boring SB-1, crushed stone fill exists from 0 to 4.8 feet BGS, and this continues out to 1 foot BGS at SB-3. Within AOC A, the soil borings were terminated at the bedrock elevation prior to encountering groundwater. The inclusion of cinders and the stratification were the same markers found on the PZ borings that indicated fill down to 17 feet BGS. The bedrock limestone was encountered at depths of 35, 15 and 15 feet at PZ-1, PZ-2 and PZ-3, respectively. The air-rotary cuttings at PZ-2 indicated a light gray limestone and a brownish-tan limestone at PZ-3. This limestone color is related to the Pond Springs Formation formerly described in **Section 2.2**.

The stiff highly plastic clay (identified as CH on the boring log **Table 4.2** and on **Figures 4-2** and **4-3**) existing under the area of the Station acts as an aquitard. The reworked clay does not contain any material other than small fragments of cinders which would detract from the natural residuum in its action as an aquitard. Natural vertical cracking of the native clays is due to it's cohesiveness and to the weathering of the underlying limestone. This process becomes pronounced over a long period. However the clays at the Station are not native, they have been

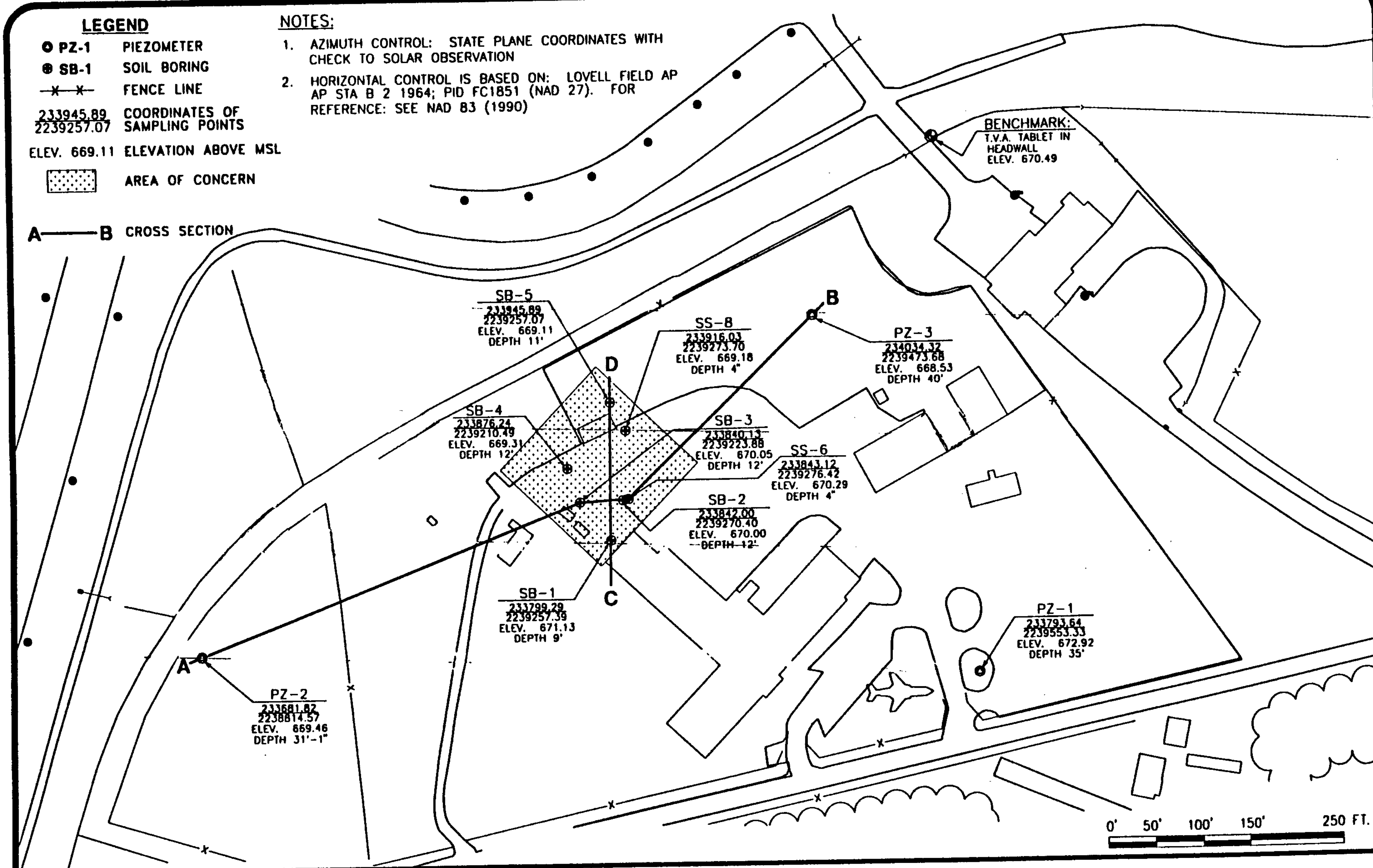

FIGURE 4-1
PIEZOMETER/GROUNDWATER CROSS SECTION LOCATIONS AT THE STATION
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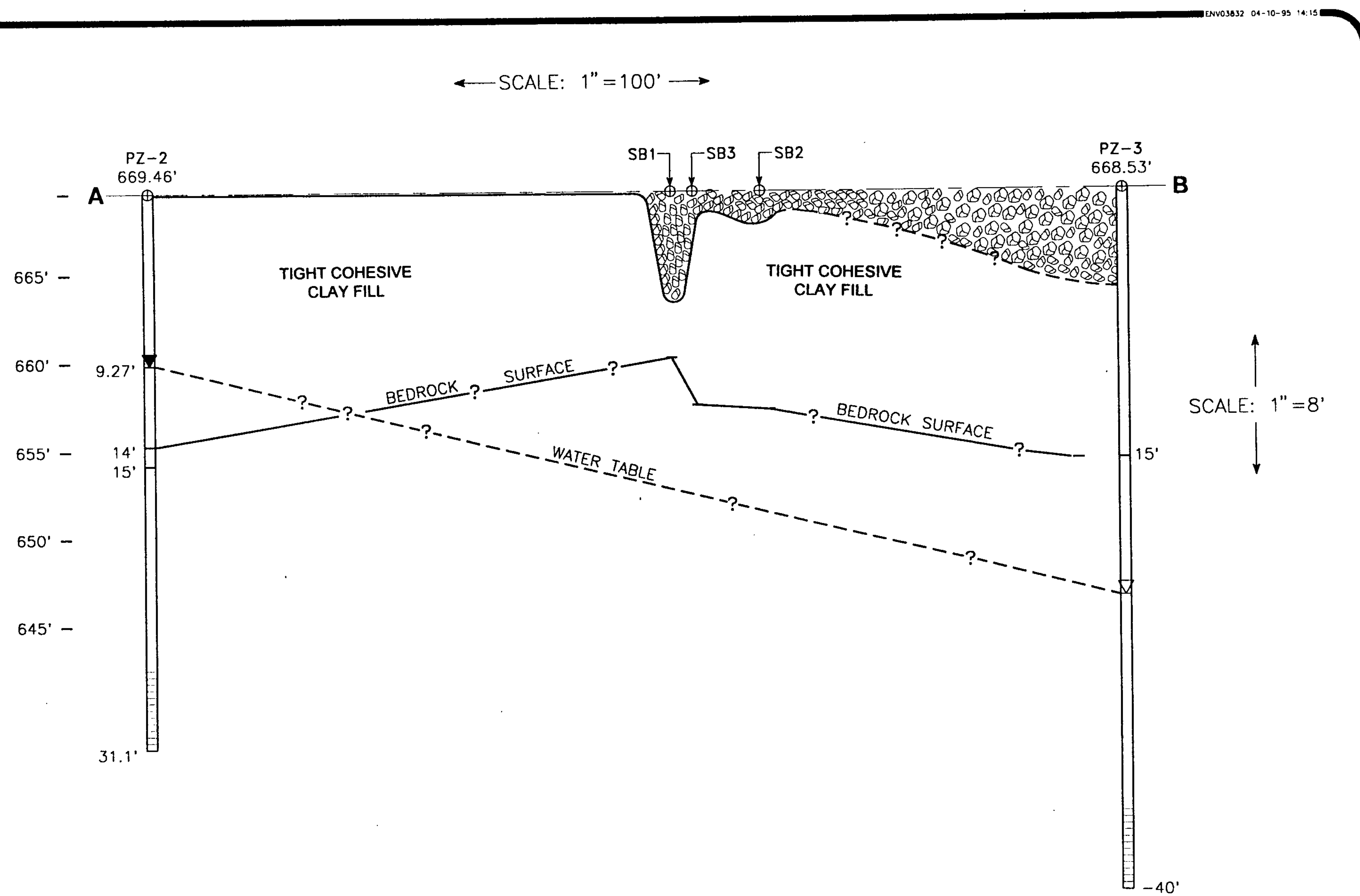

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FIGURE 4-2
HYDROLOGIC/STRATIGRAPHIC CROSS SECTION
THROUGH AOC A (A TO B)
CHATTANOOGA, TENNESSEE

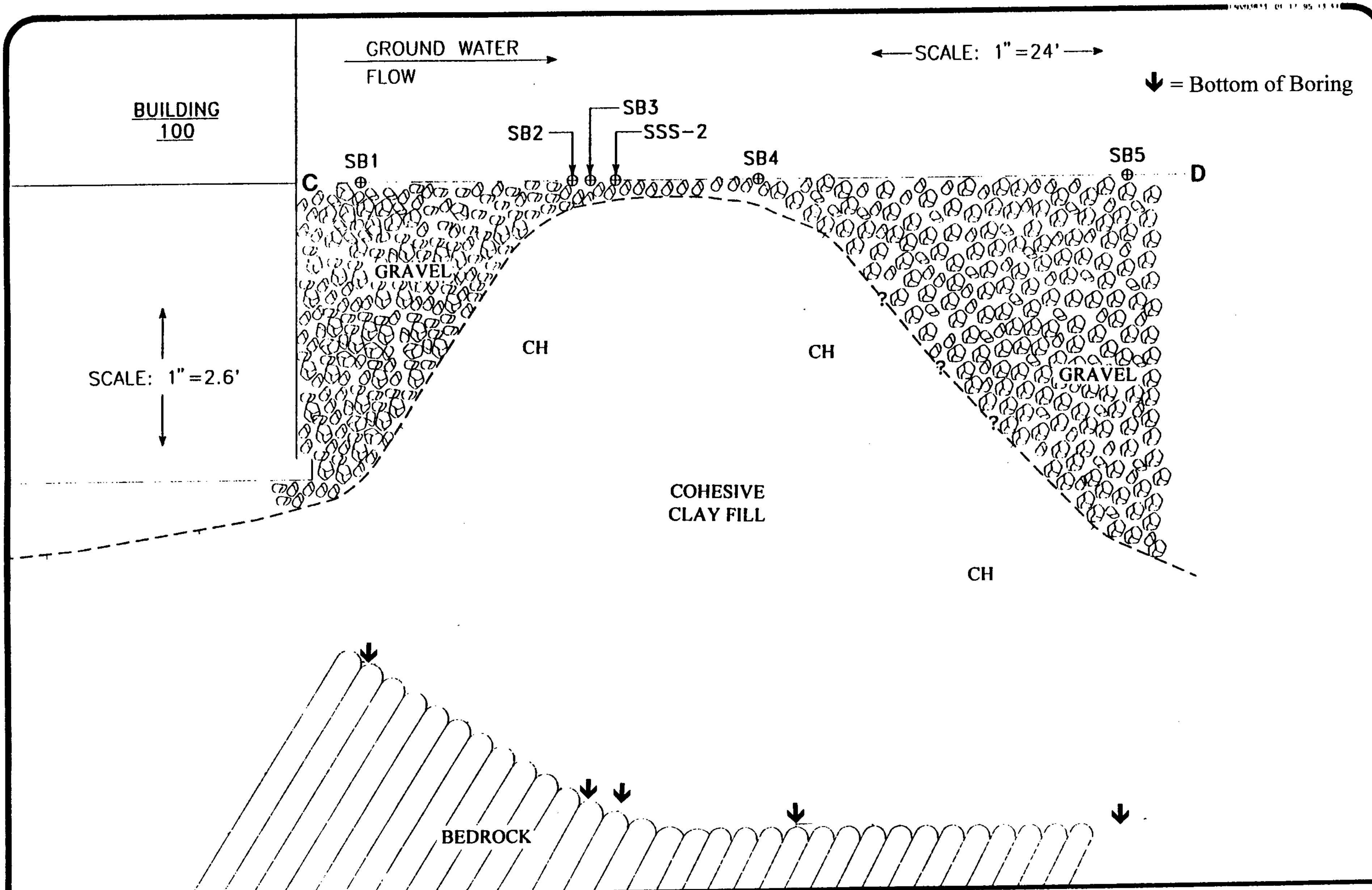

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FIGURE 4-3
HYDROLOGIC/STRATIGRAPHIC CROSS SECTION
THROUGH AOC A (C TO D)
CHATTANOOGA, TENNESSEE

TABLE 4.2 Typical Station Stratigraphy

Depth (feet)	Description
0-2	FILL - light tan CH, MC~ 20 %, Very Cohesive
2 to 27	FILL - light tan CH, MC ~ 25 %, Stiff, w/ cinders.
from 9 to 35	Bedrock Limestone

CH = Clay, highly plastic
MC = moisture content

remolded as a result of cut and fill operations associated with the construction of the Airport. The coherence of the remolded clays are best demonstrated its actions as an aquitard. This clay acts as an efficient aquitard and appears to be the cause of:

1) The long term flooding of Building 100 resulting from perched groundwater, which ANG personnel remedied by excavating to below the footer elevation around the southern end of Building 100 and backfilled with 3/4' stone to allow groundwater to flow away from the building.
2) The groundwater immediately below the pavement at Surface Sample No. 7. and
3) The perched surface-water observed in the field south-west of AOC A.

The depths at which groundwater was first encountered during the drilling of PZ-1, PZ-2 and PZ-3 boreholes, was measured as rising upward by 10, 12 and 19 feet respectively, after development, which indicated a confined aquifer (**Appendix C**). An artesian well exists upgradient of PZ-2 also indicates a confined aquifer and also could indicate underlying karst topography and/or area fracturing. Additionally, the groundwater produced by this artesian well results in a continuous supply of surface water flowing across the area where the well was installed, supporting the surficial clay layer acting as an aquitard. The hydraulic conductivity of the clay was estimated to be 2.63×10^{-7} cm/s (8.64×10^{-9} ft/s or 1×10^{-13} feet/day) by prior analysis of similar karst residuum correlated by the estimate developed in *Groundwater (Freeze and Cherry, 1979).*

Following development/purging and recovery of the piezometers, the potentiometric surface of the confined aquifer was determined by measuring the depth to the groundwater at each piezometer well. Based on these measurements, the direction of groundwater flow at the Station is toward the north (**Figure 4-4**). Abandoned PZ-1 is shown on this figure. Groundwater movement in karst bedrock typically ranges from a high of 0.80 cm/s to 1.0×10^{-4} cm/s (100 feet/year to 1×10^{-6} feet/year) *(Freeze and Cherry, Groundwater, 1979).* Based on the slow recharge observed in the piezometer wells, the groundwater flow rate in the confined aquifer at the Station is estimated to be on the low end of this range.

4.1.4 Sample Analysis

Analytical sampling results are presented in the following three subsections and conclusions in the forth. A total of 19 samples including 12 soil boring, 3 groundwater, and 4 PA/SI derived waste samples were collected and analyzed during the investigation. The analytical detection method and detection limit for each contaminant detected in soil, groundwater, and PA/SI derived waste at the Station, are presented in **Table 4.3**.

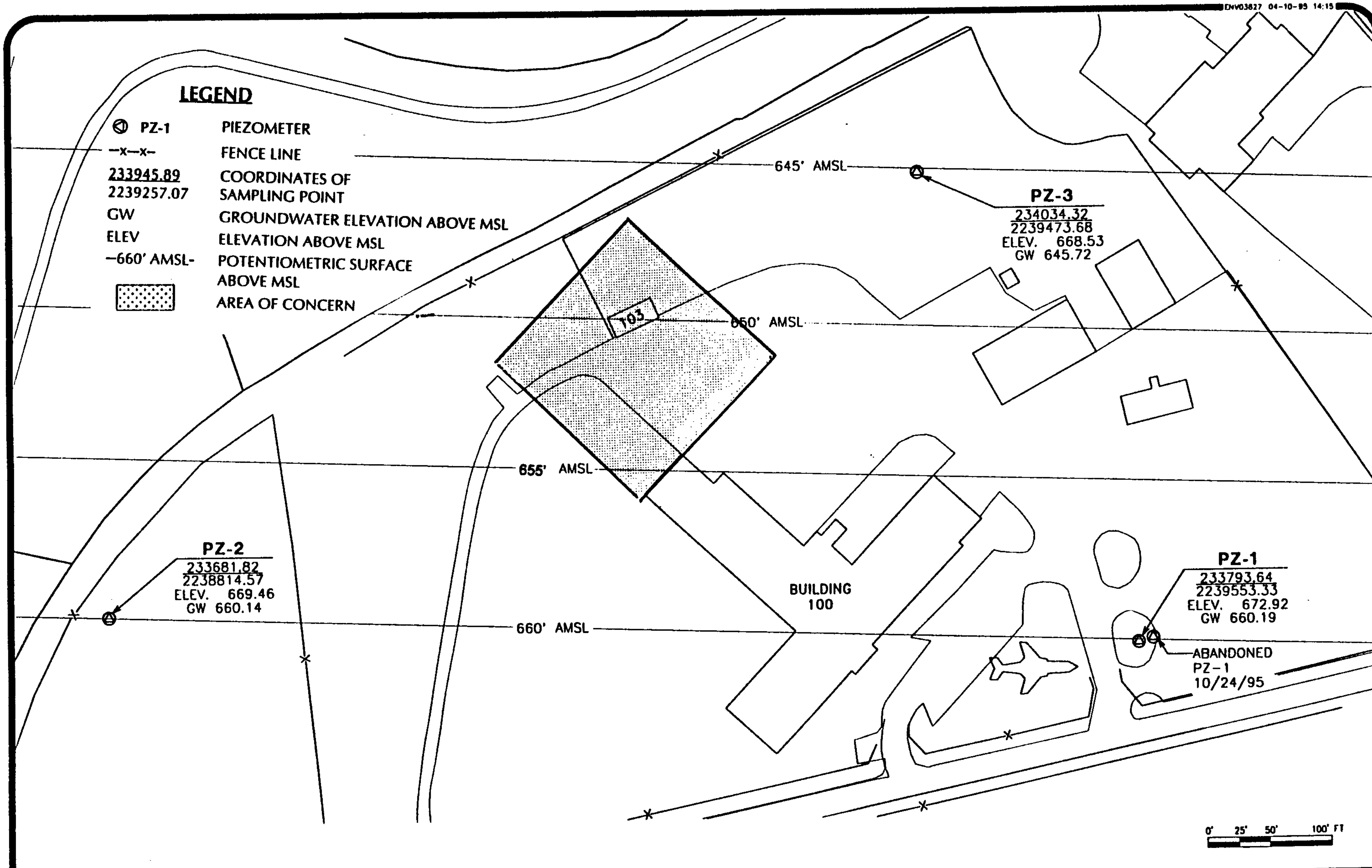

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FIGURE 4-4

POTENTIOMETRIC SURFACE MAP OF THE CONFINED AQUIFER AT AOC A
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TABLE 4.3 Detection Method and Detection Limits

Parameter	Groundwater		Soil	
	Detection Method	Detection Limits	Detection Method	Detection Limits
2-Butanone	SW-8240	10.00 μg/l	SW-8240	5.9 μg/Kg
Acetone	SW-8240	10.00 μg/l	SW-8240	11.7 μg/Kg
Methylene Chloride	SW-8240	5.00 μg/l	SW-8240	5.9 μg/Kg
Xylenes	SW-8240	5.00 μg/l	SW-8240	5.9 μg/Kg
Benzene	SW-8240	5.00 μg/l	SW-8240	5.9 μg/Kg
Carbon Disulfide	SW-8240	5.00 μg/l	SW-8240	5.9 μg/Kg
Chloroform	SW-8240	5.00 μg/l	SW-8240	5.9 μg/Kg
TPH	Cal. Modify- 8015	5.00 μg/l	Cal. Modify 8015	62 mg/Kg
Cyanide	Cal. Modify-335.2	5.00 μg/l	NA	NA
Antimony	SW-7041	1.6 μg/l	SW-7041	0.36 mg/Kg
Arsenic	SW-7060	1.3 μg/l	SW-7060	0.29 mg/Kg
Beryllium	SW-6010	1.0 μg/l	SW-6010	0.14 mg/Kg
Cadmium	SW-6010	3.6 μg/l	SW-6010	0.60 mg/Kg
Chromium	SW-6010	6.7 μg/l	SW-6010	1.1 mg/Kg
Copper	SW-6010	14.3 μg/l	SW-6010	1.3 mg/Kg
Lead	SW-7421	0.80 μg/l	SW-7421	0.18 mg/Kg
Mercury	SW-7471	0.10 μg/l	SW-7471	0.056 mg/Kg
Nickel	SW-6010	20.2 μg/l	SW-6010	4.0 mg/Kg
Selenium	SW-7740	3.0 μg/l	SW-7740	0.67 mg/Kg
Silver	SW-7761	0.40 μg/l	SW-7761	0.09 mg/Kg
Thallium	SW-7841	1.5 μg/l	SW-7841	5.00 mg/Kg
Zinc	SW-6010	8.8 μg/l	SW-6010	1.2 mg/Kg

NA = Not analyzed for

4.1.4.1 AOC A Soil Quality

A total of 12 soil samples (4 surface and 8 subsurface soil samples) were collected for laboratory analysis at AOC A from five borings (SB-1 through SB-5) and one soil-screening location (SS-2). These soil samples were collected at depths from 0 to 11-feet and were analyzed for VOC, TPH and priority-pollutant metals. The results of laboratory analysis are presented in **Table 4.4**.

Three VOCs, 2-Butanone, methylene chloride, and acetone (**Table 4.4**), were detected at AOC A. 2-Butanone was detected at an estimated concentration of 6.9 *μg/Kg,* well below the detection limit (12.2 *μg/Kg* in this sample due to dilution). Therefore, the presence of 2-Butanone is questionable. Methylene chloride was detected at concentrations ranging from 9.8 to 33.8 *μg/Kg*. Acetone was detected in most of the soil samples ranging from 5.5 *μg/Kg* to 6.4 *mg/Kg.* However, both methylene chloride (5.6 *μg/Kg*) and acetone (4.19 *μg/Kg*) were detected in the standard laboratory QA/QC clean water blank analysis. Using US EPA Risk Assessment Guidance for Superfund (RAGS) procedures (EPA, 1989), for evaluating contaminants detected in QA/QC samples, methylene chloride (a common laboratory contaminant) can be screened from consideration as a contaminant of concern, since there actual concentrations detected (from 9.8 to 33.8 *μg/Kg)* are less than ten times the concentration (5.6 *μg/Kg*) detected in the laboratory clean water blank. Although acetone (a common laboratory contaminant) was also detected in the laboratory clean water blank (4.19 *μg/Kg*), it can not be screened as a possible contaminant of concern at seven sampling locations (265 to 6,400 *μg/Kg*). The concentrations of 2-Butanone, methylene chloride and acetone are not regulated by Tennessee Department of Environmental Conservation, Underground Storage Tank Cleanup Standard (TUSTCS). Therefore these VOCs, 2- Butanone, methylene chloride and acetone were regulated by its Heath Index (HI), or potential human health significance (risk), were calculated using the maximum 6.9, 33.8 and 6,400 *μg/Kg* respectively, in accordance with RAGS. The resulting HI of 2-Butanone, methylene chloride, and acetone contaminated soil (HI = 0.0000017, 0.000007, and 0.00008, respectively) based on the accidental ingestion of soil (**Table 4.5**) are far below the level that poses a threat to human health (HI ≥ 1.0). A plan view of the location and concentration of the acetone is presented in **Figure 4.5**.

Twelve soil TPH samples were collected from five soil borings and one soil screening location at AOC A. TPH was detected in 3 samples at concentrations ranging from 102.0 to 108.0 *mg/Kg*. Compared to the Tennessee of 500 mg/Kg, the presence of TPH at AOC A is insignificant (**Table 4.6**). The results of the TPH laboratory samples were slightly higher than, but closely correlated, with the field screening results presented in **Section 4.1.1**.

Eleven of the priority-pollutant metals were detected in the soil samples (**Table 4.4**). Chromium, lead and zinc were detected in all soil samples and their concentrations ranging from 4.49 to 41.8 , 2.06 to 11.8, and 10.6 to 65.2 *mg/Kg*, respectively. Beryllium was detected in all soil borings, except SS-2, at concentrations ranging from 0.453 to 3.8 *mg/Kg*. Arsenic, copper, and nickel were detected in ten of the 12 soil samples. The maximum detected concentrations for these metals are 3.15, 13.1, and 27.0 *mg/Kg*, respectively. Cadmium was detected in six samples with concentrations ranging from 0.561 to 1.36 *mg/Kg*. Mercury was detected in nine samples at concentration ranging from 0.064 to 0.155 *mg/Kg*. Silver at a

Table 4.4 The Results of Laboratory Analysis of Soil Samples Collected At AOC A - Lovell Field ANGS

SAMPLE Sample Depth	SB-1 4-6'	SB-2 1-3'	SB-2 5-7'	SB-2 9-11'	SB-3 1-3'	SB-3 5-7'	SB-3 9-11'	SB-4 1-3'	SB-4 5-7'	SB-4 9-11'	SB-5 6-8'	SS-2 6"
Total Depth	9'	12'	12'	12'	12'	12'	12'	12'	12'	12'	11'	6"
VOCs µg/Kg												
2-Butanone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.9 J	ND
Acetone	ND	1290	5.5 j	ND	537	23.8	1810	265	3210	24.1	6400	2120
Methylene Chloride	9.8 (b)	16.9 (b)	14 (b)	19.1 (b)	33.8	11.9 (b)	23.5 (j)	14.5 (b)	24 (b)	9.31 (b)	20.6 (b)	15.8 (b)
TPH mg/Kg												
	108	106	102	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals mg/Kg												
Arsenic	1.73	1.37	2.72	ND	1.86	1.90	2.52	0.306	ND	0.82	3.15	0.98
Beryllium	1.42	2.16	0.453	1.22	0.534	0.851	0.645	3.8	1.23	1.22	1.06	ND
Cadmium	1.03	ND	ND	0.561	0.774	0.974	0.957	ND	ND	ND	1.36	ND
Chromium	26.6	26.5	27.7	34.3	21.6	13.4	31.1	41.8	19.2	22.1	24.7	4.49
Copper	9.40	12.8	ND	4.75	2.01	8.25	ND	1.79	5.13	6.17	6.87	13.1
Lead	10.5	7.22	5.92	4.54	7.50	6.15	11.1	11.8	5.11	7.55	7.42	2.06
Mercury	0.118	0.078	0.071	0.072	0.064	0.155	ND	0.064	ND	0.083	0.065	ND
Nickel	27.0	27.0	6.01	14.9	ND	26.5	7.9	20.1	13.6	15.3	19.6	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND	5.18	ND	ND	ND
Thallium	ND	0.578	ND	ND	ND	ND	ND	ND	ND	0.421	ND	ND
Zinc	62.7	65.2	16.5	34.2	10.6	60.4	17.8	27.7	40.6	36.7	50.2	14.2

ND = Below quantifiable limit or not detected
(j) = Value estimated, below method detection limit
(b) = Found in associated blank

TABLE 4.5 Non-Regulated VOC Contaminants in Soil

Exposure Medium	Contaminant	Maximum Release Concentration	RfD Value mg/Kg/day	HI	Significant? ($\Sigma HI \geq 1$)
Soil (1)	**2-Butanone**	6.9 $\mu g/Kg$	0.05 (2)	1.7×10^{-6}	**No**
Soil (1)	**Methylene Chloride**	33.8 $\mu g/Kg$	0.06	7.0×10^{-6}	**No**
Soil (1)	**Acetone**	6,400 $\mu g/Kg$	1	8.0×10^{-5}	**No**

(1) = After the age of 6 adults generally do not ingest soil. Calculation based on a child with a body mass of 16 Kg the assumed ingestion of 0.2g/day of soil is based on a 6-year exposure. period.

Using HI = ((Mc)(I)(AT)(1/W))/(RfD)(AT) where:

HI = Health Index for constitute of interest;
Mc = Maximum Concentration
W = Assumed weight of the exposed individual; and
I = Intake rate for the given period = 0.2g/day = 2 x 10-4 Kg/Kg
RfD = Reference dose developed by EPA.
AT = Average Time = (6 years(365 days/year))
(2) = Chronic effects

TABLE 4.6 TPH Contaminant Detected in Soil vs. TUSTCS, April, 1990

Contaminant	AOC A Soil	TUSTCS Soil
TPH	108 *mg/Kg* (1)	500 *mg/Kg* (2) 1000 *mg/Kg* (3)

(1) = Maximum Detected Concentration at AOC A
(2) = TUSTCS for <10-6 cm/s soil, DRINKING WATER/SOIL CLEANUP LEVEL
(3) = TUSTCS for <10-6 cm/s soil, NON-DRINKING WATER/SOIL CLEANUP LEVEL

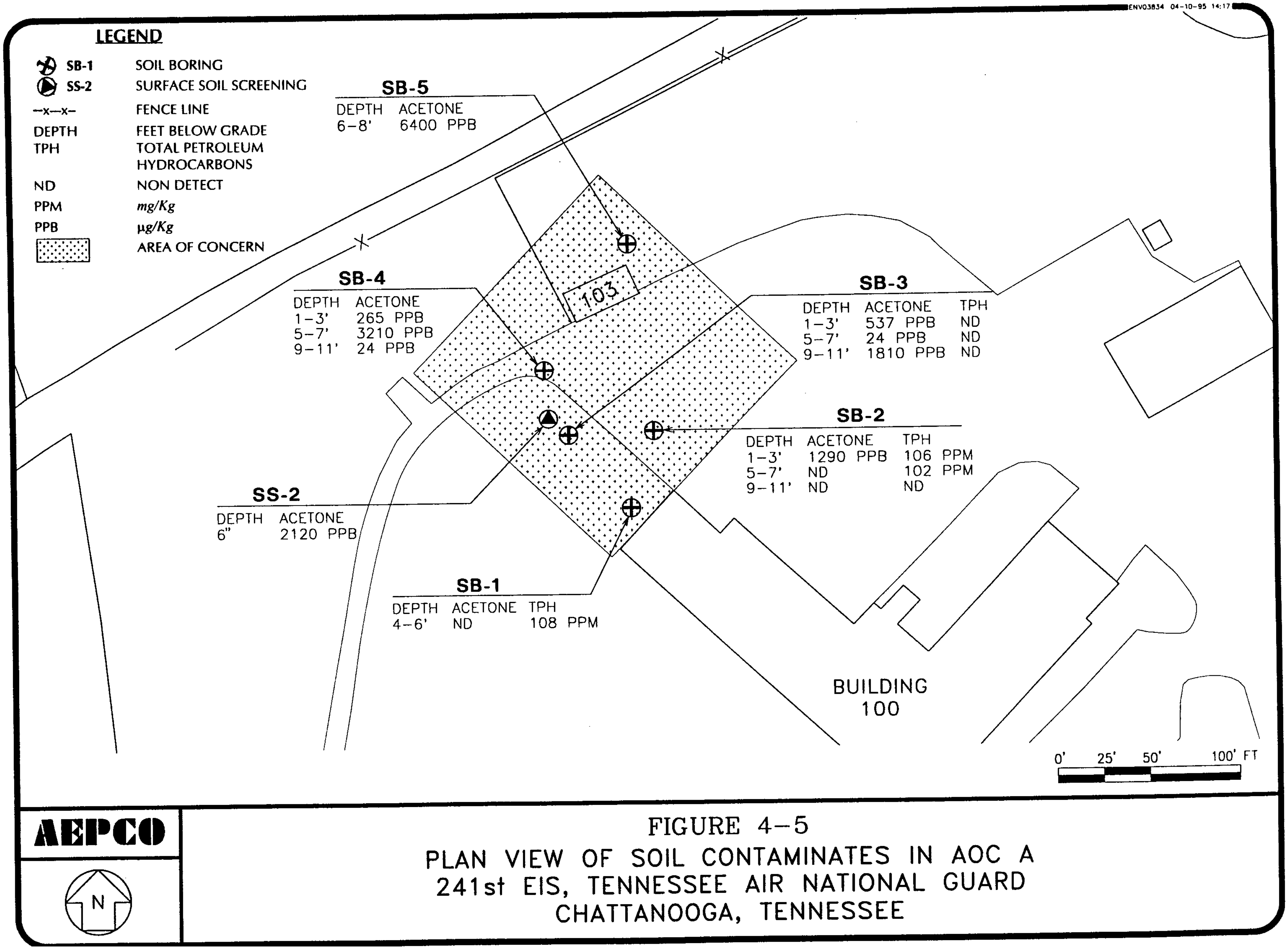

FIGURE 4-5
PLAN VIEW OF SOIL CONTAMINATES IN AOC A
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concentration of 5.18 *mg/Kg*, was detected only in SB-4 at 5-7' depth. Thallium was detected in both SB-2 (1-3') and SB-4 (9-11') at concentrations of 0.578 and 0.421 *mg/Kg*, respectively The above metals were compared to the US eastern regional and Tennessee background concentrations **Table 4.7**. All metal were within the range of the eastern US background concentrations (Volunteer Army Ammunition Site, RI/FS Draft Report. However, the concentrations of beryllium, nickel and silver exceeded the Tennessee background levels.

Table 4.7 AOC A Priority-Pollutant Metals Exceeding Native Soil Background Concentrations

Metal	Range In Detected Metals in AOC A Soils at the Station *mg/Kg*	Background Concentrations of Metals in Soil *mg/Kg*	Number of AOC A Samples Exceeding Normal Range # Samples
Arsenic	0.306 to 3.15	4.39 to 68 (1)	0
Beryllium	0.453 to 3.8	0.765 to 0.811 (1) 0.1 to 40.0 (2)	8 (1) 0 (2)
Cadmium	0.561 to 1.36	0.01 to 7.0 (2)	0
Chromium	13.4 to 41.8	6.79 to 106 (1)	0
Copper	1.79 to 13.1	4.49 to 45.1 (1)	0
Lead	2.06 to 11.8	6.47 to 230 (1)	0
Mercury	0.064 to 0.155	0.0677 to 0.25 (1)	0
Nickel	7.9 to 27.0	3.31 to 15.30 (1) < 10 to 50 (2)	1 (1) 0 (2)
Silver	5.18	1.11 to 1.49 (1) < 5 (2)	1 (1) 0 (2)
Thallium	0.421 to 0.578	48.9 to 196 (1)	0
Zinc	10.6 to 65.2	17.2 to 129 (1)	0

(1) = Volunteer Army Ammunition Plant Draft Site Investigation Report
(2) = Background for Eastern U.S.

4.1.4.2 Groundwater Quality

In addition to VOCs, TPH, and metals, groundwater samples were also analyzed for cyanide to fulfill the requirements for local sewer discharge set by City of Chattanooga Code. Groundwater samples from PZ-1, -2, & -3 were taken for laboratory analysis to determine quality of the groundwater at the Station. TPH and total cyanide were not detected in any groundwater samples. The results of groundwater analysis are presented in **Table 4.8**.

All groundwater samples collected during the PA/SI were filled with brownish clay-like particles. This may be a result of the inability to properly develop and purge the well due to their low recharge rate (see **Section 3.7.2**). To compensate for this concern, both filtered and unfiltered samples were collected and analyzed. In general, more metals and higher concentrations were detected in unfiltered samples than that of filtered samples. This confirms the presence of insoluble inorganic particles within the unfiltered samples.

Benzene was detected in PZ-1 at trace concentration of 1.16 μg/l (estimated) with detection limits of 5 μg/l. Since the detected concentration of benzene is well below its detection limit the presence of benzene is questionable (**Table 4.8**). The level of benzene detected is less than the TUSTCS (**Table 4.9**). Although methylene chloride was detected in all groundwater samples with concentrations ranging from 6.55 to 7.66 μg/l, and acetone was detected in both PZ-1 and PZ-2 at 8.54 and 41.5 μg/l, respectively, both contaminants were also detected in the laboratory blank (5.6 and 4.19 μg/l, respectively). Using RAGS procedures described in **Section 4.1.4.1** for screening contaminants identified in QA/QC sample, acetone and methylene chloride (both common laboratory contaminants) can be eliminated as being contaminants of concern in groundwater. Carbon disulfide was detected in both PZ-1 and PZ-3 at concentrations of 1.41 μg/l and 9.52 μg/l, respectively. Since carbon disulfide is not regulated under TUSTCS, its HI, or potential risk, was calculated using the maximum of 9.52 μg/l in accordance with RAGS. The resulting HI (0.0027), based on the accidental ingestion of groundwater (**Table 4.10**) is far below the level that poses a threat to human health (HI $\geq$ 1.0).

Zinc was detected in both unfiltered and filtered samples collected from PZ-1 at concentrations of 9.52 and 8.92 μg/l (**Table 4.8**), respectively. Lead was also detected in the filtered sample at PZ-1 at 7.37 μg/l. Antimony (6.72 μg/l), beryllium (3.41 μg/l); chromium (88.5 μg/l), copper (68.4 μg/l), lead (60.9 μg/l), nickel (77.5 μg/l), silver (3.97 μg/l), and zinc (393.0 μg/l) were detected in unfiltered groundwater sample collected from PZ-2; while, only lead was detected in the filtered samples at a concentration of 22.1 μg/l. Arsenic (3.24 μg/l), lead (1.41 μg/l), silver (1.12 μg/l), and zinc (26.6 μg/l) were detected in PZ-3 unfiltered sample. Only lead was detected in the filtered sample at PZ-3 (5.38 μg/l).

Table 4.11 presents the comparison of the priority-pollutant metals analysis for groundwater samples at the Station and the background levels. Background concentrations were taken from normal concentrations in groundwater for the eastern United States. One groundwater sample from PZ-2 has dissolved lead concentrations slightly exceeded the normally expected background values given in **Table 4.11**. The source of, or reason for this lead contamination in the groundwater is unknown. Lead was the only contaminant detected in groundwater media at the Station that slightly exceeds the Safe Drinking Water Action Level (Treatment Technique) of 15 μg/l. However PZ-2 is not a potable water source.

Table 4.8 The Results of Laboratory Analysis of Groundwater Samples Collected At the Station - Lovell Field ANGS

Piezometer	PZ-1		PZ-2		PZ-3	
VOCs	μg/l		μg/l		μg/l	
Carbon Disulfide	1.41 (j)		ND		9.52	
Acetone	8.54 (bj)		41.5 (b)		ND	
Benzene	1.16 (j)		ND		ND	
TPH	ND		ND		ND	
	PZ-1		PZ-2		PZ-3	
Metals	Unfiltered μg/l	Filtered μg/l	Unfiltered μg/l	Filtered μg/l	Unfiltered μg/l	Filtered μg/l
Antimony	ND	ND	6.72	ND	ND	ND
Arsenic	ND	ND	ND	ND	3.24	ND
Beryllium	ND	ND	3.41	ND	ND	ND
Chromium	ND	ND	88.5	ND	ND	ND
Copper	ND	ND	68.4	ND	ND	ND
Lead	ND	7.37	60.9	22.1	1.41	5.38
Nickel	ND	20.3	77.5	ND	ND	ND
Silver	ND	ND	3.97	ND	1.12	ND
Zinc	9.52	8.92	393.0	ND	26.6	ND

ND = Below quantifiable limit or non-detect

(j) = Value estimated, below method detection limit

(b) = Found in associated blank

TABLE 4.9 BETX Contaminants Detected in Groundwater vs. TUSTCS, April 1990

Contaminant	Station Groundwater (1) μg/l	TUSTCS Groundwater μg/l
BETX	1.16 (j)	5

(1) = Maximum Detected Concentration at the Station

(j) = Value estimated, below method detection limit

Table 4.10 Non-Regulated VOC Contaminants in Groundwater

Exposure Medium	Contaminant	Maximum Release Concentration	RfD Value *mg/Kg/day*	HI	Significant? ($\Sigma HI \geq 1$)
Groundwater [1]	**Carbon Disulfide**	9.52 μg/*l*	0.1	2.7×10^{-3}	No

(1) = Groundwater assumes an ingestion of 2 *l*/Day for 70 Kg adult with an exposure period of 70 years.

Using HI = ((Mc)(I)(AT)(1/W))/(RfD)(AT) where:

HI = Health Index for constitute of interest;
Mc = Maximum Concentration
W = Assumed weight of the exposed individual; and
I = Intake amount for the given period = 2 *l/day*
RfD = Reference dose developed by EPA.
AT = Average Time = (6 years(365 days/year))

TABLE 4.11 Range of Priority-Pollutants Compared to Natural Groundwater Concentrations

Metal	Range in Filtered Groundwater Samples at the Station	Concentrations of Background in Groundwater [1]	Number of Groundwater Samples Exceeding Eastern U.S. Concentrations
	μg/*l*	μg/*l*	# Samples
Lead	5.38 to 22.1 (PZ-1,2,3)	< 15	1 [2]
Nickel	20.3 (PZ-1)	< 10 to 50	0
Zinc	8.92 (PZ-1)	< 10 to 2000	0

(1) = Background for Eastern U.S. Groundwater
(2) = SAFE DRINKING WATER MCL: treatment technique, action level of 15 μg/*l*

4.1.4.3 SI Derived Waste Sampling Analysis

A soil and development (liquid) sample from each of the wastes generated from piezometers (PZ-1, 2, & 3) installation were collected for VOC, TPH, and priority-pollutant metals, and submitted to the laboratory. The liquid waste sample from the decontamination pad was collected for VOC, TPH, and priority-pollutant metals, and submitted to the laboratory. Cyanide samples were taken from the development and decon waste (to comply with City of Chattanooga Code, June 1990). Cyanide was not detected in any liquid waste sample. The results are presented in **Tables 4.12** and **4.13**.

The VOC, TPH, and priority-pollutant metals contaminate characteristic of the piezometer development waste was based on the resultant analytical data from the groundwater sample from each piezometer. Soil boring drill cuttings were based on the soil samples from each boring (See **Section 4.1.4.1** and **4.1.4.2**).

Methylene chloride was detected in all three piezometer wastes at concentrations ranging from 5.26 to 39.3 *μg/Kg* and acetone was detected in PZ-2 and PZ-3 at concentrations of 11.2 and 14.8 *μg/Kg*, respectively. Both contaminants were also detected in the lab blank (5.6 and 4.19 *μg/Kg*). These VOCs could be screened for the same reason as discussed in **Section 4.1.4.1**. Xylenes were detected in PZ-2 waste at an estimated concentration of 1.76 *μg/Kg* which is well below the detection limit (5.9 *μg/Kg*) and xylenes were not detected in any other samples collected at the Station. TPH was detected in PZ-3 drill cutting (composite sample) at 91.8 *mg/Kg*. PZ-3 is located in an area which is used for parking by the Station, thus, it is not unexpected that TPH exists in the surface soil in the area. The TPH and BETX detected contaminants do not exceed the TUSTCS (**Table 4.14**). Using RAGS procedures described in **Section 4.1.4.1** for screening contaminants identified in the QA/QC sample, methylene chloride (a common laboratory contaminant) can be eliminated as being contaminants of concern in the PA/SI derived waste. Although acetone (a common laboratory contaminant) was also detected in the clean water laboratory blank, it can not be screened at the concentration of 197 *μg/l*. Acetone at this concentration is at trace levels and is well below the subchronic Reference Dose (RfD) of 1.0 *mg/l* and is not a contaminant of concern. Acetone at this level is not listed as a Hazardous Waste under Resource Conservation and Conservation Act (RCRA). Carbon disulfide is listed by RCRA at as not exceeding 25,000 *μg/l*, therefore carbon disulfide (at 7.5 *μg/l*) is not considered a Hazardous Waste. Chloroform was detected at 3.83 *μg/l* is well below the City of Chattanooga Sewer Use and Industrial Wastewater Discharge Regulations maximum influent concentration of 193 *μg/l* and is far below the maximum concentration (6,000 *μg/l*) of contaminants for the toxicity characteristic under RCRA (40CFR 261.24 Table 1). Chloroform, acetone and carbon disulfide are compared to these regulatory levels in **Table 4.15**.

Nine metals were detected in PA/SI derived wastes as presented in **Table 4.13**. These metals were compared with eastern region of US and Tennessee Background (Volunteer Army Ammunition Plant Draft RI/FS Investigation Report) concentrations and the results are presented in **Table 4.16.** Only nickel slightly exceeds Tennessee background concentrations. None of the metals exceeds the eastern US background levels.

The PA/SI derived wastes are currently stored at the Station awaiting a determination of acceptable disposal options.

TABLE 4.12 Summary Of Generated Waste Detected VOC, Cyanide, and TPH Analytical Results ($\mu g/Kg^1$)

Development Waste ID	Acetone	Methylene Chloride	Xylenes	Carbon Disulfide	Chloro-form	Cyanide	TPH *mg/Kg*
PZ -1$^{(1)}$	ND	7.92	ND	ND	ND	ND	ND
PZ -2$^{(1)}$	11.2 $^{(j)}$	39.3 $^{(b)}$	1.76 $^{(j)}$	ND	ND	ND	ND
PZ -3$^{(1)}$	14.8	5.3 $^{(j)}$	ND	ND	ND	ND	91.8
Decon$^{(2)}$	197 $^{(b)}$	6.08 $^{(b)}$	ND	7.5	3.83 $^{(j)}$	ND	ND

(j) = Value estimated, below method detection limit
(b) = Found in associated blank
$^{(1)}$ = All values in $\mu g/Kg$ except TPH which is *mg/Kg*
$^{(2)}$ = Values in $\mu g/l$

Table 4.13 Summary Of Generated Waste Priority-Pollutant Metals Analytical Results

Derived Waste ID	PZ-1^1	PZ-2^1	PZ-3^1	DECON^2
Arsenic	2.18	1.45	0.751	ND
Beryllium	0.876	0.351	0.228	ND
Cadmium	0.658	ND	ND	ND
Chromium	30.0	14.0	12.4	39.2
Copper	9.44	1.68	3.79	18.7
Lead	8.91	4.91	1.79	2.00
Mercury	0.084	ND	0.058	ND
Nickel	18.9	8.85	11.6	ND
Zinc	45.2	24.0	24.5	10.6

1 = Concentrations in $\mu g/Kg$
2 = Concentrations in $\mu g/l$

Table 4.14 TPH/BETX Contaminants Detected in PA/SI Derived Waste vs. TUSTCS, April, 1990

Contaminant	Decon Liquid µg/l	TUSTCS Groundwater µg/l	PZ Drilling Soil mg/Kg	TUSTCS Soil mg/Kg
Xylenes	ND	10,000 (3)	1.8 (j)	100 (1) 500 (2)
BETX	ND	BENZENE 5.0 (3) ETHYLBENZENE 700 (3) TOLUENE 1,000 (3) XYLENES 10,000 (3)	1.8 (j)	100 (1) 500 (2)
TPH	ND	100 (1) 1,000 (2)	91.8	500 (1) 1,000 (2)

ND = Below quantifiable limit or not detected
NA = Not available
(b) = Detected in the subsequent Clean Water Blank
(j) = Value estimated, below method detection limit
(1) = TUSTCS for $<10^{-6}$ cm/s soil, DRINKING WATER/SOIL CLEANUP LEVEL
(2) = TUSTCS for $<10^{-6}$ cm/s soil, NON-DRINKING WATER/SOIL CLEANUP LEVEL
(3) = TUSTCS VOC

Table 4.15 Non- Regulated VOC Contaminants in PA/SI Derived Waste

Exposure Medium	Contaminant of Concern	Maximum Concentration	Regulation	Concern?
Groundwater	**Acetone**	197 µg/l	1,000 *µg/l/Day*(1)	No
Groundwater	**Chloroform**	3.83 µg/l	193 µg/l(2) 6,000 µg/l(3)	No
Groundwater	**Carbon Disulfide**	9.52 µg/l	25,000 µg/l(4)	No

(1) = RfD of 1 *mg/Kg/Day* ≅ 1 *mg/l/Day* = 1,000 *µg/l/Day*
(2) = Code of Chattanooga, Sewer Use and Industrial Wastewater Discharge Regulations
(3) = 40 CFR 261.24 Table 1
(4) = Discharge Limit (40 CFR 261.3 (B))

Table 4.16 PA/SI Derived Waste Priority-Pollutant Metals vs. Native Soil Background Concentrations

Metal	Range In Detected Contaminant in PA/SI Derived Wastes *mg/Kg*	Concentrations of Background Contaminant in Soil *mg/Kg*	Number of AOC A Samples Exceeding Normal Range # Samples
Arsenic	0.751 to 2.18	4.39 to 68 (1)	0
Beryllium	0.228 to 0.876	0.765 to 0.811 (1) 0.1 to 40.0 (2)	1 (3) 0
Cadmium	0.658	0.01 to 7.0 (2)	0
Chromium	12.4 to 30	6.79 to 106 (1)	0
Copper	1.68 to 9.44	4.49 to 45.1 (1)	0
Lead	1.79 to 8.91	6.47 to 230 (1)	0
Mercury	0.058 to 0.084	0.0677 to 0.25 (1)	0
Nickel	8.85 to 18.9	3.31 to 15.30 (1) < 10 to 50 (2)	1 (3) 0
Zinc	24.0 to 45.2	17.2 to 129 (1)	0

(1). = Volunteer Army Ammunition Plant Draft Site Investigation Report

(2) = Background for Eastern U.S.

(3) = Does not exceed background metals for Eastern U.S.

4.1.5 Conclusions

Several VOCs potentially exist in the soil at AOC A, with acetone showing the most undeniable presence in AOC A soil. Acetone occurs at insignificant concentrations ranging from 0.0055 to 6.40 *mg/Kg.* was evaluated with the risk associated with accidental ingestion. The HI of ingestion of acetone in soil does not pose any threat to human health effects and are therefore considered to be insignificant at these concentrations.

A total of fourteen surface soil samples (eight from screening, one surface soil, and five surface soil from borings) and seven subsurface soil samples were taken in a 150' by 150' area. TPH was detected in three grab samples from two borings installed in the gravel/clay layer near the end of Building 100. With the exception of the composite drill cutting sample from PZ-3, (a side-gradient well) also installed in a parking lot, no other evidence of TPH was found. Thus, the TPH contamination associated with AOC A is confined to a small area. The localized TPH (maximum 108 *mg/Kg*) contamination in soil samples collected at AOC A does not exceed the stricter soil $>10^{-6}$ permeability for soil above a drinking water aquifer TSUSTCS of 500 *mg/Kg* and therefore is of no concern.

All the metals in the soil at AOC A fall below the Eastern United States background concentrations. Metals contamination in AOC A soils is not a concern.

The groundwater samples were collected from piezometer wells located outside of the suspected area of contamination. Carbon disulfide potentially exist in the groundwater beneath the Station at an insignificant concentrations ranging from 1.41(j) to 9.52 *μg/l.* This presence was evaluated with the risk associated with accidental ingestion. The HI of ingestion of carbon disulfide in groundwater does not pose a threat to human health and are therefore considered to be insignificant at these concentrations. All other VOCs, acetone and methylene chloride were screened from consideration.

Several metals were detected in groundwater samples collected from piezometer wells. Of these metals, only filtered lead (from PZ-2) exceeds the Safe Drinking Water Action Level Treatment Technique (22.1 vs. 15 *μg/l*). The source of the lead (22.1 *mg/Kg*) in the groundwater from PZ-2, located side-gradient of AOC A, is unknown. PZ-2 is not currently nor will it be used as a source of potable water, therefore is of no concern.

SI Derived Waste does not contain any TPH, VOCs, cyanide, or metals above the regulatory levels and therefore does not pose any threat to human health and are therefore considered to be insignificant.

5.0 SUMMARY AND CONCLUSIONS

A summary and conclusions of the SI, data limitations, and recommendations for future work are presented in the following sections.

5.1 Summary

A review of the Station records and interviews with current Guard personnel resulted in the identification of AOC A. Handling and disposal of waste at this site was reported to have contributed to a localized contamination at the Station. This PA/SI has investigated AOC A.

A localized area of TPH soil contamination exists (TPH ranging from 102 to 108 *mg/Kg*) from three samples were identified in the parking area within AOC A that does not exceed the TUSTCS of 500 *mg/Kg*.

Soil sampling within AOC A also detected a traceable low level contamination of acetone. Acetone based on the HI risk assessment does not pose any threat to human health effects and are therefore insignificant at these concentrations.

Priority-pollutant metals contamination in AOC A soil are all within expected regional background concentrations.

The groundwater samples were collected from piezometer wells located outside of the suspected area of contamination Groundwater samples collected from the Station detected carbon disulfide. The HI of ingestion of carbon disulfide contaminated groundwater (HI = 0.0027) is far below the level that poses a threat to human health (HI ≥ 1.0).

Lead was detected in filtered groundwater samples from, PZ-2 at 22.1 *μg/l*. The concentration of lead in groundwater from PZ-2 is above the background level and Drinking Water Corrective Action Level Treatment Technique of < 15 *μg/*. AOC A is sidegradient with respect to PZ-2 and, therefore, it can not be considered as the source of the lead contamination. In addition, PZ-2 is installed solely for hydrogeological investigation purpose. The presence of lead in PZ-2 is insignificant because PZ-2 will never be used as a potable water source.

SI derived waste analysis detected acetone, carbon disulfide, TPH, and 9 priority-pollutant metals. Acetone, carbon disulfide and chloroform all fall well below the regulatory levels. TPH was detected in development waste from PZ-3 (91.8 *mg/Kg*), which is also a gravel covered parking area, and falls below the TUSTCS of 500 *mg/Kg*. Cyanide was not detected in any sample. The priority-pollutant metals detected were arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, and zinc. All of the metals fall below the background conditions.

5.2 Conclusions

The localized TPH concentrations (108, 106 and 102 *mg/Kg*) in AOC A do not exceed the TUSTCS that establish the upper limit of 500 *mg/Kg*. This area is used as a vehicle parking area and is topped with gravel and the TPH is bound in the cohesive clay that has a very low hydraulic conductivity (~3 x 10^{-13} feet per day).

No conditions were found that would preclude the aquifer beneath the Station from being used as a drinking source with exception to the localized lead contamination found in PZ-2. The presence of dissolved lead in groundwater from PZ-2 at 22.1 *µg/l* can not be attributed to any activities occurring at AOC A. The source of the lead in the groundwater from PZ-2, located side-gradient of AOC A, is unknown.

VOCs in soil and groundwater all fall well below regulatory (HI) levels.

PA/SI generated waste contains no significant contamination.

6.0 Recommendations

Considering the information collected and analyzed during the SI, sound engineering judgment should be applied to preclude any future releases of hazardous materials at the Station.
No follow up work is deemed necessary.

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APPENDIX A

TECHNICAL MEMORANDA ON FIELD ACTIVITIES

FIGURE 5-3 Field Change Request Form

Field Change No. LF-1
Page 1 of 1
Date: 10/25/94

Project Name/No.: LOVELL FIELD ANGS PA/SI			
Applicable Document:			
Description of Change: DELETE SURFACE SOIL SCREENING SAMPLE #7			
Reason for Change: SURFACE SAMPLING LOCATION EXISTS UNDER PAVEMENT. WHEN PAVEMENT WAS REMOVED THE SAMPLING LOCATION HAD 3+" OF STANDING WATER IN IT.			
Recommended Disposition: ~~SINCE~~ GT. IF SS-6, 5 AND 8 SHOWED LESS THAN 15 PPM (ESSENTIALLY 0) THEREFORE SS-7 CAN BE ELIMINATED			
Impact on Present and Completed Work: NONE			
Requested By: George Tonson / Wei Lin **Field Operations Leader/Field Manager**			
Approved	**Rejected**	**Signatures**	**Date**
✓		ANGRC PROJECT ~~Project~~ Manager: Winston K. [illegible]	10-26-94
		QA Officer:	
Final Disposition: SINCE SS-6, 5 AND 8 HAVE NO INDICATION OF TPH (LESS THAN 15PPM) CONTAMINATION, SS-7 WILL BE DELETED			
Signature: [illegible] **Date:** 10/25/94			

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FIGURE 5-3 Field Change Request Form

Field Change No. LF2
Page 1 of 1
Date: 10/27/94

Project Name/No.:	Lovell Field ANG PA/SI 2059-007
Applicable Document:	
Description of Change:	Use of stainless steel split spoon for surface & subsurface soil sampling is changed to use steel split spoon
Reason for Change:	Stainless steel split spoon samplers are not available at the site.
Recommended Disposition:	use steel split spoon samplers for surface & subsurface sampling
Impact on Present and Completed Work:	insignificant
Requested By:	George D. Tousa PG.
Field Operations Leader/Field Manager	

Approved	Rejected	Signatures	Date
✓		ANGRC Project Manager: [signature]	10/28/94
		QA Officer:	

Final Disposition:

Signature: [signature] **Date:** 10/28/94

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FIGURE 5-3 Field Change Request Form

Field Change No. LF3
Page 1 of 1
Date: 10/27/94

Project Name/No.: Lovell Field ANG PA/SI 2059-007

Applicable Document:

Description of Change: Definitions of surface, near surface and subsurface soil are revised due to site specific conditions and the use of 2-ft split spoon samplers.

Reason for Change: 1. Depths of the black-top (parking lot) at AOC A are between 2" to 14". 2. Boring #1 is covered by approximately 4' of gravel. 3. 2-ft of split spoon samplers are used to collect all soil samples.

Recommended Disposition: 1. Surface soils are collected from 0' to 2'. 2. Delete near surface soil from the sample ID list. 3. Two subsurface soil samples will be collected at each boring (SUS 5'-7', 10'-12')

Impact on Present and Completed Work: None

Requested By: George D. Jonson P.G.

Field Operations Leader/Field Manager

Approved	Rejected	Signatures	Date
✓		ANGRC Project Manager: [signature]	10/28/94
		QA Officer:	

Final Disposition:

Signature: [signature] PG **Date:** 10/28/94

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FIGURE 5-3 Field Change Request Form

Field Change No. LF4
Page 1 of 1
Date: 10/27/94

Project Name/No.: Lovell Field ANG PA/SI 2059-007

Applicable Document:

Description of Change: Only one soil sample is collected at AOC A Boring #1

Reason for Change: 1. Boring #1 is covered by 4' gravel; surface soil is not available. 2. Encounter bedrock at 7' in lieu of ~~groundwater~~

Recommended Disposition: 1. Collect subsurface soil sample at the depth of 4'~6' at Boring #1. 2. Collect a surface soil sample at the location of soil screening sample #2 to confirm the level of contamination.

Impact on Present and Completed Work: Insignificant

Requested By: George D. Townsend

Field Operations Leader/Field Manager

Approved	Rejected	Signatures	Date
✓		ANGRC Project Manager: [signature]	10/28/94
		QA Officer:	

Final Disposition:

Signature: [signature] **Date:** 10/28/94

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FIGURE 5-3 Field Change Request Form

Field Change No. LF-005
Page ____ of ____
Date: 10/28/94

Project Name/No.: Lovell Field ANG

Applicable Document:

Description of Change: Resampling of Soil Boring #2, 3 and 4

Reason for Change: Omission of VOC samples in these ~~wells~~ borings due to lack of sampling material

Recommended Disposition: Resampling of these borings immediately adjacent to the previous location

Impact on Present and Completed Work: Insignificant

Requested By: George Towsen PE.

Field Operations Leader/Field Manager

Approved	Rejected	Signatures	Date
✓		ANGRC **Project Manager:** [signature]	10/28/94
		QA Officer:	

Final Disposition:

Signature: [signature] P.E. **Date:** 10/28/94

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FIGURE 5-3 Field Change Request Form

Field Change No. LF-6
Page ____ of ____
Date: 10/28/94

Project Name/No.: Lovell Field ANG

Applicable Document:

Description of Change: Combination of Developing and Purging of P2-2

Reason for Change: Due to very low Recharge

Recommended Disposition: Combination of Development and Purging by Bailing the well Dry Continuously on 10/28/94 and Allowing Recharge to occur for sampling on 10/29/94

Impact on Present and Completed Work: Additional Filtered Metals Sample

Requested By: George Towson PG.

Field Operations Leader/Field Manager

Approved	Rejected	Signatures	Date
✓		ANGRC Project Manager: [signature]	10/28/94
		QA Officer:	

Final Disposition:

Signature: [signature] **Date:** 10/28/94

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FIGURE 5-3 Field Change Request Form

Field Change No. LF 7
Page 1 of 1
Date: 10/28/94

Project Name/No.: Lovell Field ANG PA/SI 2059-007	
Applicable Document:	
Description of Change: Protective Locking Lids for piezometers	
Reason for Change: Locking Lids will require an external lock ~~which~~ on the top of the piezometer, which may present a hazard to grass cutting and/or other activities	
Recommended Disposition: A Locking cap type to replace the protective locking Lid as proposed in the work plan.	
Impact on Present and Completed Work: None	
Requested By: George Towson 10/28/94 Field Operations Leader/Field Manager	

Approved	Rejected	Signatures	Date
✓		ANGRC Project Manager: [signature]	10/28/94
		QA Officer:	

Final Disposition:

Signature: [signature] **Date:** 10/28/94

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FIGURE 5-3 Field Change Request Form

Field Change No. LF8
Page 1 of 1
Date: 10/28/94

Project Name/No.:			
Applicable Document:			
Description of Change: Concrete pad of piezometer with a radius of 3 ft' sloping away from the piezometer.			
Reason for Change: 3 ft radius is a typo of 3 ft' diameter.			
Recommended Disposition: The Concrete pad of piezometer be constructed with a diameter of 3 ft' sloping away from the piezometer.			
Impact on Present and Completed Work: None			
Requested By: [signature] **Field Operations Leader/Field Manager**			
Approved	**Rejected**	**Signatures**	**Date**
✓		**Project Manager:** [signature]	10/28/94
		QA Officer:	
Final Disposition:			
Signature: [signature] **Date:** 10/28/94			

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FIGURE 5-3 Field Change Request Form

Field Change No. LF9
Page 1 of 1
Date: 10/28/94

Project Name/No.: Lovell Field ANG PA/SI 2059-007

Applicable Document:

Description of Change: Soil Boring #5 Subsurface & Surface Soil Samples

Reason for Change: FINE GRAVEL EXISTS FROM 0-1' FROM 1' TO 8' BELOW GRADE HAD 3 TO 4" GRAVEL. AT 8' TO 9.5' A TAN STIFF CLAY, (CH), EXISTS AND WE TOOK A VOC AND A TPH/METALS SAMPLE. FROM 9.5 TO 11' HAD CRUSHED GRAVEL.

Recommended Disposition: ONLY ONE SAMPLE OF VOC AND TPH/METALS. IF PRESENT FUEL/SOLVENT STORAGE FACILITY IS LEAKING THE CLAY AT 8' WHICH WE SAMPLED WILL SHOW ANY ~~[illegible]~~ GOOD LEAKING.

Impact on Present and Completed Work: INSIGNIFICANT.

Requested By: GEORGE TOWSON P.G.
Field Operations Leader/Field Manager

Approved	Rejected	Signatures	Date
		Project Manager:	
		QA Officer:	

Final Disposition:

Signature: [illegible] P.G. Date: 10/28/94

August 1994

APPENDIX B

ANALYTICAL DATA AND QA/QC EVALUATION RESULTS

AS REQUIRED BY THE STATEMENT OF WORK ONE COPY OF THE LABORATORY RESULTS FOR THIS DELIVERY ORDER WERE FORWARDED UNDER SEPARATE COVER TO ANGRC

APPENDIX C

SOIL BORING LOGS

GEOLOGIC WELL BORING LOG

BORING NO.: PZ-1
CLIENT: ANGRC
JOB NO.: 2059-007
LOCATION: Lovell ANGS
FOL\GEOLOGIST: G Towson PG.
DRILLER: A. Davis
CONTRACTOR: Christen Boyles
RIG TYPE: Mobile Drill Rig
METHOD: HSA
BORING DIA.: 4.25" ID
DRILLING FLUID: None
TSPC: 233653.03662 N, 2239648.744439E
DATE START: 10/24/94
DATE COMPLETED: 10/25/95
ELEVATION: 676.53
TEMP.: 62 to 74°F
WEATHER: Partly Cloudy / Sunny
COMMENTS:

Depth (ft)	Profile	US CS	Geologic Description	Sample No.	Sample Depth	Sample Type	Penetrat. Resistance	HNu
1'		CH	FILL - light tan fat clay, moisture content ~ 20%, very cohesive	1	0-2'	D	2-2-2-2	0.0
6'		CH	FILL - light tan fat clay, moisture content ~ 12%, stiff, with small limestone fragments	2	5-7'	D	4-7-9-11	0.0
11'		CH	FILL - light tan fat clay, moisture content ~ 12%, stiff, with small limestone fragments.	3	10-12'	D	2-3-3-6	0.0
16'		CH	FILL - light tan fat clay, moisture content ~ 12%, stiff, with small limestone fragments	4	15-17'	D	2-3-36	0.0
21'		CH	Light tan fat clay, moisture content ~25%, plastic	5	20-22'	D	3-22-50/2	0.0
26'	∇	CH	Light tan fat clay, moisture content ~25%, plastic	6	25-27'	D	3-8-50/3"	0.0
35'			Bedrock					

Sample Type
D - DRIVE
C - CORE
G - GRAB

GEOLOGIC WELL BORING LOG

BORING NO.: PZ-2
CLIENT: ANGRC
JOB NO.: 2059-007
LOCATION: Lovell ANGS
FOL\GEOLOGIST: G Towson PG.
DRILLER: A. Davis

CONTRACTOR: Christen Boyles
RIG TYPE: Mobile Drill Rig
METHOD: HSA to Air Rotary
BORING DIA.: 4.25" ID
DRILLING FLUID: None
TSPC: 233681.81518 N, 2338814.57493 E

DATE START: 10/25/94
DATE COMPLETED: 10/26/95
ELEVATION: 669.46
TEMP.: 65 to 78°F
WEATHER: Sunny / Partly Cloudy

COMMENTS:

Depth (ft)	Profile	US CS	Geologic Description	Sample No.	Sample Depth	Sample Type	Penetrat. Resistance	HNu
1'		CH	FILL - gray-tan fat clay and clayey sand-moisture content ~ 15%, very cohesive	1	0-2'	D	1-3-4-7	0.0
6'		CH	FILL - gray-tan fat clay, moisture content ~ 15%, soft, with cinders.	2	5-7'	D	2-3-5-41	0.1
11'		CH SM	FILL - light brown tan fat clay to silty sand, moisture content ~ 25%, soft,	3	10-12'	D	1-5-7-41	0.1
14'		GW	Weathered bedrock limestone gravel	4	12-14'	D	2-3-36	0.2
21'	∇		Competent bedrock		21'		*	0.1
					26'			0.0
31.1			Bottom of well boring		31..1			0.0

* Air Rotary

Sample Type
D - DRIVE
C - CORE
G - GRAB

GEOLOGIC WELL BORING LOG

BORING NO.: PZ-3
CLIENT: ANGRC
JOB NO.: 2059-007
LOCATION: Lovell ANGS
FOL\GEOLOGIST: G Towson PG.
DRILLER: A. Davis
CONTRACTOR: Christen Boyles
RIG TYPE: Mobile Drill Rig
METHOD: HSA - Air Rotary
BORING DIA.: 4.25" ID
DRILLING FLUID: None
TSPC: 234034.32025 N, 2239282.70977 E
DATE START: 10/25/94
DATE COMPLETED: 10/26/95
ELEVATION: 668.53
TEMP.: 62 to 74°F
WEATHER: Sunny / Partly Cloudy
COMMENTS:

Depth (ft)	Profile	US CS	Geologic Description	Sample No.	Sample Depth	Sample Type	Penetrat. Resistance	HNu
1'		GW	FILL - Crushed limestone gravel	1	0-2'	D	12-13-12-14	0.0
6'		GW to CH	FILL - Crushed gravel to light tan fat clay	2	5-7'	D	34-15-5-10	0.0
11'		CH	FILL - light tan to white fat clay, MC ~ 12%, soft, w/cinders.	3	10-12'	D	3-5-70-40	0.0
13'		CL	FILL - light tan fat clay, Soft, w/cinders to limestone.	4	13-15'	D	50/3"	0.0
15'			Bedrock limestone				*	0.0
								0.0
	∇							0.0
								0.0
40'			Bottom of well boring					

moisture content = Moisture Content

Sample Type
D - DRIVE
C - CORE
G - GRAB

GEOLOGIC BORING LOG

BORING NO.: (AOC A)-SB-1
CLIENT: ANGRC
JOB NO.: 2059-007
LOCATION: Lovell ANGS
FOL\GEOLOGIST: G Towson PG.
DRILLER: A. Davis

CONTRACTOR: Christen Boyles
RIG TYPE: Mobile Drill Rig
METHOD: HSA
BORING DIA.: 4.25" ID
DRILLING FLUID: None
TSPC: 233799.29 N, 2239257.39 E

DATE START: 10/27/94
DATE COMPLETED: 10/27/95
ELEVATION: 671.13
TEMP.: 62 to 74°F
WEATHER: Sunny

COMMENTS:

Depth (ft)	Profile	US CS	Geologic Description	Sample No.	Sample Depth	Sample Type	Penetrat. Resistance	HNu
1'		GW	Crushed stone	1*	0-2'	D	9-5-2-3	0.0
4'		GW	Crushed stone to 6' below ground surface	2*	3-5'	D	4-6-4-7	0.0
6'		GW to CH	Fill tan moist fat clay with cinders	3**	5-7'	D	5-7-9-12	0.1
9'			Bedrock, auger refusal	4*	9'	D	0	0.1

* - VOC, Metals & TPH Sample attempted but very low sample retention resulted in failed sample
** - VOC, Metals & TPH Sample

Sample Type
D - DRIVE
C - CORE
G - GRAB

GEOLOGIC BORING LOG

BORING NO.: (AOC A)-SB-2
CLIENT: ANGRC
JOB NO.: 2059-007
LOCATION: Lovell ANGS
FOL\GEOLOGIST: G Towson PG.
DRILLER: A. Davis

CONTRACTOR: Christen Boyles
RIG TYPE: Mobile Drill Rig
METHOD: HSA
BORING DIA.: 4.25" ID
DRILLING FLUID: None
TSPC: 233842.00 N, 2239270.40 E

DATE START: 10/27/94
DATE COMPLETED: 10/27/95
ELEVATION: 670.00
TEMP.: 62 to 74°F
WEATHER: Sunny

COMMENTS:

Depth	Profile	US CS	Geologic Description	Sample		Sample	Penetrat.	HNu
(ft)				No.	Depth	Type	Resistance	
1'			8" Pavement, crushed stone to 2' below ground					0.0
4'		GW to CH	Fill tan moist fat clay with cinders	1**	3-5'	D	3-3-3-5	0.0
8'		CH	Fill tan moist fat clay with cinders	3	7-9'	D	6-8-9-12	0.1
11		CH	Fill tan moist fat clay	4**	10-12'	D	6-12-12-14	0.1
12'			Limestone bedrock, auger refusal	5*	12'	D	0	0.1

* - VOC, Metals & TPH Sample attempted but very low sample retention resulted in failed sample
** - VOC, Metals & TPH Sample

Sample Type
D - DRIVE
C - CORE
G - GRAB

GEOLOGIC BORING LOG

BORING NO.: (AOC A)-SB-3
CLIENT: ANGRC
JOB NO.: 2059-007
LOCATION: Lovell ANGS
FOL\GEOLOGIST: G Towson PG.
DRILLER: A. Davis

CONTRACTOR: Christen Boyles
RIG TYPE: Mobile Drill Rig
METHOD: HSA
BORING DIA.: 4.25" ID
DRILLING FLUID: None
TSPC: 233840.13 N, 2239223.88 E

DATE START: 10/27/94
DATE COMPLETED: 10/27/95
ELEVATION: 670.05
TEMP.: 62 to 74°F
WEATHER: Sunny

COMMENTS:

Depth (ft)	Profile	US CS	Geologic Description	Sample No.	Sample Depth	Sample Type	Penetrat. Resistance	HNu
2'		CH	1' Crushed stone to fill tan moist fat clay	1**	1-3'	D	8-8-13-12	0.0
6'		CH	Fill tan-brown moist fat clay with cinders	2**	5-7'	D	8-8-12-14	0.1
10'		CH to SM	Fill tan-brown moist fat clay fill to brown silty-sand	3**	9-11'	D	2-11-5-50/1"	0.0
12'			Auger refusal	4*	12'	D	0	0.0

** - VOC, Metals & TPH Sample

Sample Type
D - DRIVE
C - CORE
G - GRAB

GEOLOGIC BORING LOG

BORING NO.: (AOC A)-SB-4
CLIENT: ANGRC
JOB NO.: 2059-007
LOCATION: Lovell ANGS
FOL\GEOLOGIST: G Towson PG.
DRILLER: A. Davis
COMMENTS:

CONTRACTOR: Christen Boyles
RIG TYPE: Mobile Drill Rig
METHOD: HSA
BORING DIA.: 4.25" ID
DRILLING FLUID: None
TSPC: 233876.24 N, 2239210.49 E

DATE START: 10/27/94
DATE COMPLETED: 10/27/95
ELEVATION: 669.31
TEMP.: 62 to 74°F
WEATHER: Sunny

Depth	Profile	US CS	Geologic Description	Sample		Sample	Penetrat.	HNu
(ft)				No.	Depth	Type	Resistance	
1'		CH	Fill tan-brown wet fat clay with cinders	1**	1-2	D	2-2-3-4	0.0
6'		CH	Fill tan-brown moist fat clay with cinders	2**	5-6	D	5-7-9-12	0.0
11'		CH	Fill gray brown fat clay over fill tan-brown wet fat clay	3**	10-12	D	4-1-1-50/2"	0.0
12'			Auger refusal	4*	12	D	0	0.0

* - VOC, Metals & TPH Sample attempted but very low sample retention resulted in failed sample
** - VOC, Metals & TPH Sample

Sample Type
D - DRIVE
C - CORE
G - GRAB

GEOLOGIC BORING LOG

BORING NO.: (AOC A)-SB-5
CLIENT: ANGRC
JOB NO.: 2059-007
LOCATION: Lovell ANGS
FOL\GEOLOGIST: G Towson PG.
DRILLER: A. Davis

CONTRACTOR: Christen Boyles
RIG TYPE: Mobile Drill Rig
METHOD: HSA
BORING DIA.: 4.25" ID
DRILLING FLUID: None
TSPC: 233945.89 N, 2239257.07 E

DATE START: 10/28/94
DATE COMPLETED: 10/28/95
ELEVATION: 669.11
TEMP.: 62 to 74°F
WEATHER: Sunny

COMMENTS:

Depth (ft)	Profile	US CS	Geologic Description	Sample No.	Sample Depth	Sample Type	Penetrat. Resistance	HNu
0-7'		GW	7' Crushed stone from 1" to 6"+ diameter	1*	0-7'	D	18-20-24-33	0.0
9'		CH	Fill tan-brown stiff fat clay with cinders	2**	8-9.5'	D	12-7-15-21	0.1
10'		GW	Crushed limestone gravel	3*	9.5-11'	D	8-33-18-50/2"	0.0
11'			Limestone bedrock auger refusal	4*	11'		0	0.0

* - VOC, Metals & TPH Sample attempted but very low sample retention resulted in failed sample
** - VOC, Metals & TPH Sample

Sample Type
D - DRIVE
C - CORE
G - GRAB

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG

#1

NAME OF DRILLER	Al Davis
DATE OF BORING	10-27-94
METHOD OF DRILLING	3 1/4 HSA to 12'
TYPE OF SAMPLER	2" SPT every 5'
SURFACE ELEVATION	
COORDINATES OF PZ	

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG
#2

NAME OF DRILLER	Al Davis
DATE OF BORING	10-27-94
METHOD OF DRILLING	3 1/4" HSA to 12
TYPE OF SAMPLER	2" SPT every 5'
SURFACE ELEVATION	
COORDINATES OF PZ	

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG
#3

NAME OF DRILLER	Al Davis
DATE OF BORING	10-27-94
METHOD OF DRILLING	3 1/4" HSA to 12'
TYPE OF SAMPLER	2" SPT every 5'
SURFACE ELEVATION	
COORDINATES OF PZ	

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG

#4

NAME OF DRILLER	Al Davis
DATE OF BORING	10-27-94
METHOD OF DRILLING	3 1/4" HSA to 12'
TYPE OF SAMPLER	2" SPT every 5'
SURFACE ELEVATION	
COORDINATES OF PZ	

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG
#5

NAME OF DRILLER	Al Davis
DATE OF BORING	10-28-94
METHOD OF DRILLING	3 1/4" HSA to 11
TYPE OF SAMPLER	2" SPT every 5'
SURFACE ELEVATION	
COORDINATES OF PZ	

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG

2A

NAME OF DRILLER	Al Davis
DATE OF BORING	10-28-94
METHOD OF DRILLING	3 1/4" HSA to 12'
TYPE OF SAMPLER	2" SPT every 5'
SURFACE ELEVATION	
COORDINATES OF PZ	

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG

3A

NAME OF DRILLER	Al Davis
DATE OF BORING	10-28-94
METHOD OF DRILLING	3 1/4" HSA to 12'
TYPE OF SAMPLER	2" SPT every 5'
SURFACE ELEVATION	
COORDINATES OF PZ	

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG
4A

NAME OF DRILLER	Al Davis
DATE OF BORING	10-28-94
METHOD OF DRILLING	3 1/4 HSA to 9'
TYPE OF SAMPLER	2" SPT every 5'
SURFACE ELEVATION	
COORDINATES OF PZ	

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG

PZ-1

NAME OF DRILLER	Al Davis
DATE OF BORING	10/26/94
METHOD OF DRILLING	4 1/4" hollow stem auger to 25'
TYPE OF SAMPLER	2" SPT every 5'
SURFACE ELEVATION	676.53
COORDINATES OF PZ	TSPC
	233653.03662 N
	2239648.74439 E

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG

PZ-2

NAME OF DRILLER	Al Davis
DATE OF BORING	10/25/94
METHOD OF DRILLING	Auger to 15.0 4 1/4" HSA Air Rotary to 31.0 5 7/8"
TYPE OF SAMPLER	2" SPT every 5' in soil
SURFACE ELEVATION	669.46'
COORDINATES OF PZ	TSPC
	233681.81518 N
	2338814.57493 E

CHRISTENSEN BOYLES
CORPORATION

AEPCO

BORING LOG

PZ-3

NAME OF DRILLER: Al Davis

DATE OF BORING: 10-25-94

METHOD OF DRILLING: 4 1/4" hollow stem auger to 15'
5 7/8" air rotary to 41.5'

TYPE OF SAMPLER: 2" SPT every 5' in soil

SURFACE ELEVATION: 628.5'

COORDINATES OF PZ: TSPC
234034.32025 N
2239282.70977 E

APPENDIX D

ADPM RANKING

AUTOMATED DEFENSE PRIORITY MODEL

LOVELL AIR NATIONAL GUARD

Input Data

General Site Information

```
-> DERPMIS ID     = arnld
   Installation   = ARNOLD AFB*
   Location       = Chattanooga, TN
   Reviewer       = M. Hopkins
   Reviewer's address    = AEPCO, 15800 Crabbs Branch Way, Rockville, MD
   Reviewer's facsimile #    = (30) 670-9844
   Reviewer's phone #    = (301) 670-6770
   Service  = Air Force
   Site name      = Lovell Air National Guard
```

* Due to the requirement for a Derpmis ID to initiate modelling, Arnold AFB, Arnold, TN was utilized due to its locality and comparable precipitation values.

AUTOMATED DEFENSE PRIORITY MODEL

LOVELL AIR NATIONAL GUARD

Input Data

Surface Water Pathways

```
->[1] Detected releases in surface water = no
  [2] Distance to nearest surface water = 0.02 miles
  [3],[16],[26],[37] Net precipitation = 14 inches
  [4a] Surface erosion potential = none
  [5a] Site location relative to Mississippi = east
  [5b] 1 year 24 hour rainfall intensity = 3.25 inches
  [6a] Hydraulic conductivity = 3.04800600E-17 cm/sec
  [7] Flooding potential = moderate
  [10e] Spill = moderately_effective
  [11,21,33,45] Spill waste quantity = 6000 gallons
```

Groundwater Pathways

```
->[13] Detected releases in groundwater = no
  [14a] Depth to the groundwater table = 6 feet
  [14b] Short circuit potential = high
  [15a] Impermeable hydraulic conductivity = 2.00000000E-17 cm/sec
  [15b] Impermeable layer thickness = 8 feet
  [16] Infiltration potential = moderate
  [3],[16],[26],[37] Net precipitation = 14 inches
  [17] Geochemical properties of the vadose zone = none
  [20e] Spill = ineffective
  [11,21,33,45] Spill waste quantity = 6000 gallons
```

AUTOMATED DEFENSE PRIORITY MODEL

LOVELL AIR NATIONAL GUARD

Input Data

Air Volatiles Pathways

```
->[23] Detected release of volatiles in air  = no
  [24] Detected release of volatiles in soil  = yes
  [25] Average summer soil temperature = 22 degree C
  [3],[16],[26],[37] Net precipitation = 14 inches
  [27],[38] Annual average wind speed  = 7 miles/hour
  [28] Porosity of the soil = 0.0001
  [32e] Spill = ineffective
  [11,21,33,45] Spill waste quantity = 6000 gallons
```

Air Dust Pathways

```
->[35] Detected release of nonvolatiles in air  = no
  [36] Detected release of nonvolatiles in soil  = yes
  [3],[16],[26],[37] Net precipitation = 14 inches
  [27],[38] Annual average wind speed  = 7 miles/hour
  [39] Days/year with precipitation higher than 0.25 mm = 109
  [40] Activity at site = moderate
  [44e] Spill = ineffective
  [11,21,33,45] Spill waste quantity = 6000 gallons
```

AUTOMATED DEFENSE PRIORITY MODEL

LOVELL AIR NATIONAL GUARD

Input Data

CONTAMINANT HAZARD --- SURFACE WATER

HAZARD WORKSHEET -- Non-Detected Releases

Contaminant Name	CAS No.	Health Hazard Score	Eco Hazard Score
Acetone	67-64-1	1	2
Methyl ethyl ketone	78-93-3	1	1
Methylene chloride	75-09-2	1	1
TPH (Total Petroleum Hydrocarb	(No Value)	2	2

MAX HEALTH HAZARD SCORE 2

MAX ECOLOGICAL HAZARD SCORE 2

CONTAMINANT HAZARD --- GROUNDWATER

HAZARD WORKSHEET -- Non-Detected Releases

Contaminant Name	CAS No.	Rf	Adj Health Hazard Score	Adj Eco Hazard Score
Acetone	67-64-1	18.559100	0.0538819	0.1077638
MEK	78-93-3	29.427083	0.0339823	0.0339823
Methylene chloride	75-09-2	69.032283	0.0144859	0.0144859
TPH (Total Petroleum Hydroca	(No Value)	730.58242	0.0027375	0.0027375

MAX HEALTH HAZARD SCORE 0

MAX ECOLOGICAL HAZARD SCORE 0

AUTOMATED DEFENSE PRIORITY MODEL

LOVELL AIR NATIONAL GUARD

Input Data

CONTAMINANT HAZARD --- AIR/SOIL VOLATILE PATHWAY

HAZARD WORKSHEET -- Detected Releases

Contaminant	CAS No.	Soil Conc.	Units	Air Conc.	Units	Health Benchmrk (ug/day)	Health Hazard Quotient
Acetone	67-64-1	6.4	mg/kg	6e-10	g/M3	210000	5.7e-08
Methylene chlor	75-09-2	0.034	mg/kg	8e-11	g/M3	43.8	3.4e-05
MEK	78-93-3	0.005	mg/kg	1e-11	g/M3	6300	3.6e-08
TPH (Total Petr	(No Value)	108	mg/kg	4e-11	g/M3	6020	1.4e-07

SUM OF HEALTH HAZARD QUOTIENTS 3.5e-05

SCORE 0

ECOLOGICAL HAZARD --- AIR/SOIL VOLATILE PATHWAY

HAZARD WORKSHEET -- Detected Releases

Contaminant	CAS No.	Soil Conc.	Units	Air Conc.	Units	Ecologic Benchmrk (ug/day)	Ecologic Hazard Quotient
Acetone	67-64-1	6.4	mg/kg	6e-10	g/M3	1070	5.6e-10
Methylene chlor	75-09-2	0.034	mg/kg	8e-11	g/M3	160000	4.7e-13
MEK	78-93-3	0.005	mg/kg	1e-11	g/M3	274000	4.1e-14
TPH (Total Petr	(No Value)	108	mg/kg	4e-11	g/M3	1000000	4.2e-14

ECOLOGICAL HAZARD QUOTIENT SUM 5.6e-10

SCORE 0

AUTOMATED DEFENSE PRIORITY MODEL

LOVELL AIR NATIONAL GUARD

Input Data

CONTAMINANT HAZARD --- AIR/SOIL DUST PATHWAY

HAZARD WORKSHEET -- Detected Releases

Contaminant Name	CAS No.	Soil Conc.	Units	Air Conc.	Units	Health Benchmrk (ug/day)	Health Hazard Quotient
Lead	7439-92-1	0.06	mg/kg	5e-12	g/M3	30	0.00033

SUM OF HEALTH HAZARD QUOTIENTS 0.00033

SCORE 0

ECOLOGICAL HAZARD --- AIR/SOIL DUST PATHWAY

HAZARD WORKSHEET -- Detected Releases

Contaminant Name	CAS No.	Soil Conc.	Units	Air Conc.	Units	Ecologic Benchmrk (ug/day)	Ecologic Hazard Quotient
Lead	7439-92-1	0.06	mg/kg	6e-12	g/M3	5000	1.2e-12

ECOLOGICAL HAZARD QUOTIENT SUM 1.2e-12

SCORE 0

AUTOMATED DEFENSE PRIORITY MODEL

LOVELL AIR NATIONAL GUARD

<u>Input Data</u>

Human Health Receptors -- Surface Water Pathway

```
->[87a] Population drinking from surface water within 3 miles = 25000
  [88] Water use of nearest surface water body(ies) = high
  [89a] Population within 0.1 miles of the site - surface water = 175
  [89b] Population within 0.25 miles of the site - surface water = 175
  [89c] Population within 0.5 miles of the site - surface water = 450
  [90] Distance to installation boundary - surface water = 100 feet
  [91a] Land use and/or zoning within 1 mile of the site = moderate
```

Ecological Receptors -- Surface Water Pathway

```
->[94a] Importance/sensitivity of biota/habitats 3 miles = slight
  [94b] Importance/sensitivity of biota/habitats 4 miles = moderate
  [95a] Presence of "critical environments" - surface water = absent
  [95b] Presence of "critical environments" - surface water = absent
```

AUTOMATED DEFENSE PRIORITY MODEL

LOVELL AIR NATIONAL GUARD

Input Data

Human Health Receptors -- Groundwater Pathway

```
->[98a] Groundwater travel time (years) to wells = dn/ki = 0.05
  [99a] GW travel time (years) to surface water-3 miles = dn/ki = 0.0000
  [99b] Distance from waste location to surface water =d = 15840.00 feet
  [100] Groundwater use of the uppermost aquifer = high
  [101a] Population at risk from groundwater contamination = 20
  [101b] Groundwater users vulnerability = low
  [102a] Population within 0.1 miles of the site - groundwater = 175
  [102b] Population within 0.25 miles of the site - groundwater = 175
  [102c] Population within 0.5 miles of the site - groundwater = 450
  [103] Distance to installation boundary - groundwater = 100 feet
```

Ecological Receptors -- Groundwater Pathway

```
->[106a] Groundwater travel time (years) to natural area = dn/ki = 0.05
  [107a] Importance/sensitivity of biota/habitats -3 miles = slight
  [107b] Importance/sensitivity of biota/habitats -4 miles = moderate
  [108a] Presence of "critical environments" - groundwater = absent
  [108b] Presence of "critical environments" - groundwater = absent
```

AUTOMATED DEFENSE PRIORITY MODEL

LOVELL AIR NATIONAL GUARD

Input Data

Human Health Receptors -- Air/soil Pathway

->[111a] Population within 0.25 mile of the site - air/soil = 175
[111b] Population within 0.5 mile of the site - air/soil = 450
[111c] Population within 1 mile of the site - air/soil = 1600
[112a] Distance to industrial-commercial site = 200 feet
[113] Distance to installation boundary - air/soil = 100 feet

Ecological Receptors -- Air/soil Pathway

->[116a] Distance to nearest coast - air/soil = 2112000.00 feet
[116b] Distance to nearest freshwater - air/soil = 4000 feet
[116c] Distance to nearest critical habitat - air/soil = 21120.00 feet

F I N A L   S C O R E S

Installation :
Site name : Lovell Air National Guard

[120]	Surface water human health score	6.0
[121]	Surface water ecological score	2.6
[122]	Ground water human health score	0.0
[123]	Ground water ecological score	0.0
[124]	Air/soil volatiles human health score	0.0
[125]	Air/soil volatiles ecological score	0.0
[126]	Air/soil dust human health score	0.0
[127]	Air/soil dust ecological score	0.0
[128]	sqrt(5x[120]^2 + [121]^2 + 5x[122]^2 + [123]^2 + 5x[124|126]^2 + [125|127]^2	13.6
[129]	Overall site score	3.2

APPENDIX E

FEDERAL FACILITY DOCKET DATA REQUIREMENTS

APPENDIX E

PRELIMINARY ASSESSMENT/SITE INSPECTION DATA REQUIREMENTS FOR FEDERAL FACILITY DOCKET SITES

LOVELL AIR NATIONAL GUARD, TENNESSEE

The questions for which data is provided are given in Attachment 1.

1. The required data for this question are identified in the pertinent SI report sections, including figures and appendices:

	Section(s)/Figure(s)/Appendix
Sampling Data:	**4.1.4.1, 4.1.4.2, 4.1.4.3**
Location Map:	**Figures 1-1, 1-2**
Equipment Detection Limits:	**4.1.4**
Raw Data Sheets:	**Appendix B**
QA/QC Documents:	**N/A**
Date(s) Sampled:	**Appendix B**
Analytical Method(s) Used:	**4.1.4**
Well or Boring Logs:	**Appendix C**
Sampling technique(s):	**3.7**

2. **Known or Suspected Sources:**

   See attached Table 1-1 for area and chemicals of concern.

3. **Aquifers:**

   The major aquifer present beneath the site is the Valley and Ridge Aquifer (otherwise known as the Cambrian-Ordovician). This is a confined aquifer composed of carbonate, sandstone, and shale. Nearly all of the high-producing wells and springars are in the dolomitic limestone formations present in the aquifer. Well yields commonly range from 5 to 200 gal/min.[1] The top of the aquifer, or the water bearing zone, is reported to be 79 feet below the ground surface.

4. **Groundwater Containment:**

   Ground water containment, as designated by EPA Docket Table 1, is described as no evidence of hazardous substance migration from source area.

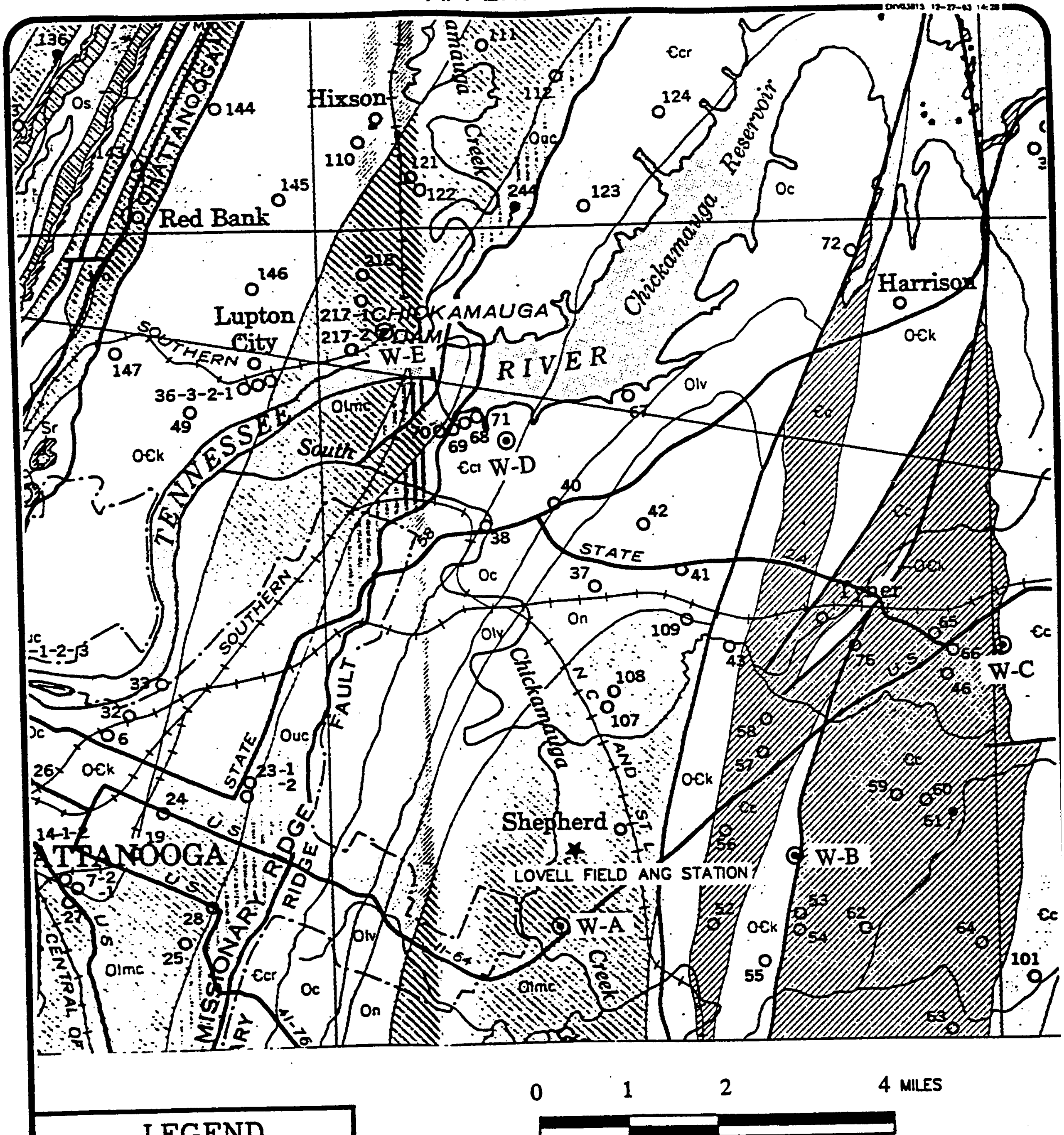
5. **Drinking Water Wells:**

   See attached topographic map (Figure A-1) for designated drinking water (WD-) wells being utilized in the area.

Table 1-1 Quantities of Wastes Generated and Disposal Methods
Lovell Field ANGS

SHOP		QUANTITIES DISPOSED PER/YEAR	DISPOSAL METHODS			
			1960s	1970s	1980s	1990s
AUTO SHOP/ POWER PRODUCTION	Solvents/PD-680/MEK/Xylene/Toluene	8 gal.	CON	CON	DRMO	DRMO
	Battery Acid	10-15 gal.	NEU/OWS	NEU/OWS	MANUF	MANUF
	Paint Thinner	8 gal.	CON	CON	CON	DRMO
	Hyd./Trans./Brake/Engine Oil	250 gal.	GND	GND/DRMO	DRMO	DRMO
	Antifreeze Fluid	15 gal.	DRN	DRN	DRN	DRMO

CON - Consumed in use
DRMO - Disposed of through the DoD Reutilization and Marketing Office
GND - Disposed of on ground
NEU - Neutralized
OWS - Oil/Water Separator
DRN -Disposed of through the public sewer drain



LEGEND

★ LOVELL FIELD ANGS
○ WELL LOCATION (BY TDG)
⊙ WELL LOCATION (BY TDEC)

SOURCE:
1.TN. DEPT. OF ENVIRONMENT AND CONSEVATION,RECORDS OF WATER WELLS IN TENNESSEE, 1993.
2.TN. DIVISION OF GEOLOGY, GROUND-WATER RESOURCES OF EAST TENNESSEE, 1956.

AEPCO

N

FIGURE A-1
LOCATION OF GROUND WATER WELLS NEAR LOVELL FIELD, 241st EIS, TENNESSEE ANG CHATTANOOGA, TENNESSEE

APPENDIX E

6. **Other Use Water Wells:**

   Well 70 (as indicated on the attached topographic map - Figure A-1) is the only water well currently being utilized for livestock watering.

7. **Population:**

   The average number of persons per residence for Hamilton County, according to population and housing statistics in 1990, is calculated to be 2.3. [2]

8. **Surface Water Bodies (see attached topographical maps - Figures A-2 and A-3):**

   (a) South Chickamauga Creek: 3/8 miles west of site. Flows northward to the Tennessee River.
   (b) Tennessee River: Mean annual flow rate is 35,393 cubic feet per second.

9. **Surface Water Containment:**

   Surface water containment is designated, as described in EPA Docket Table 2, as having no evidence of hazardous substance migration from source area.

10. **Drainage Basin:**

    The number of acres in the drainage basin is approximately 1200 acres based on a topographic analysis resulting in an area approximately 2 miles by 1 mile.

11. **Drainage Area Soil Type:**

    The soil type predominant in the largest total area of the drainage basin is categorized (according to EPA Docket Table 3) as a fine-textured soil with very low infiltration rate.

12. **Rainfall:**

    The 2 year, 24 hour rainfall is 15 inches for the area.[3]

13. **Floodplain Category:**

    The floodplain category for the site is that the source area is within the 100-year floodplain. Since there is no migration of hazardous substances, EPA Docket Table 5 criterion are not applicable.

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FIGURE A-2
(East Chattanooga Quadrangle)

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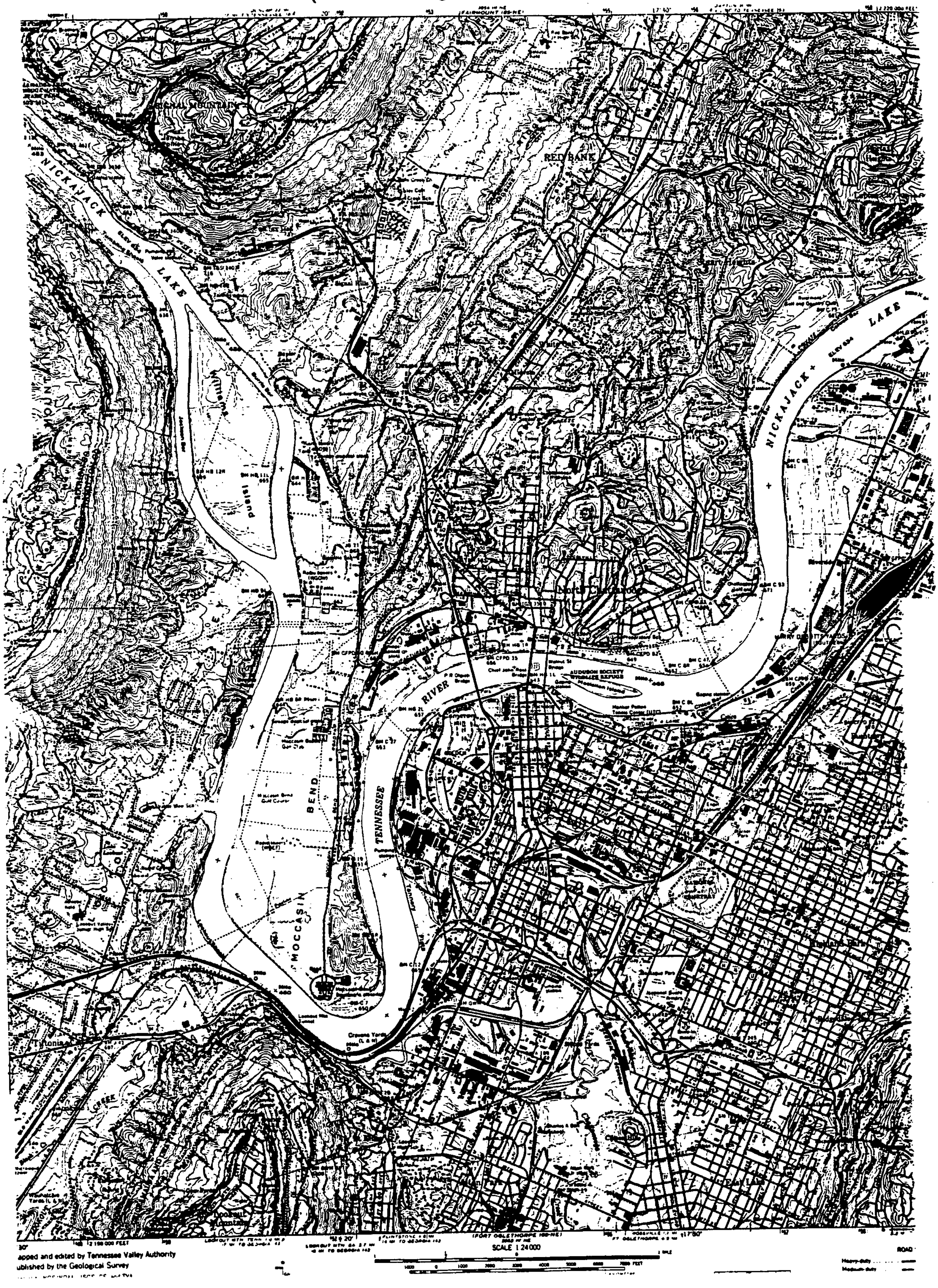
FIGURE A-3
(Chattanooga Quadrangle)



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14. **Drinking Water Intakes:**

The main drinking water intake within 15 downstream miles is the Tennessee River which supplies water to the City of Chattanooga and several adjacent communities including the station. The intake of the water filtration plant is located three miles downgradient from the confluence of South Chickamauga Creek and the Tennessee River, which is approximately 14 miles downgradient of the station. It also supples both intake and outtake of the Chickamauga Lake and Nickajack Lakes which are met at the confluence of the South Chickamauga Creek. The population served is approximately 286,000.

15. **Non-Drinking Water Intakes (other):**

As indicated above, the Tennessee River is the main drinking water zone utilized for all purposes, including commercial and industrial processes.

16. **Surface Water Body Utilized for Drinking Water:**

The Tennessee River is the water source for the Tennessee-American Water Company that supplies water for the City of Chattanooga and several adjacent communities.

17. **Surface Water Body - Human Food Chain Production:**

It has been estimated by members of the Tennessee Department of Environment and Conservation that the average food chain production consists of:

- 3000 fish pounds per year from the Nickajack Lake area of the Tennessee River
- 20 fish pounds per year from the Chickamauga Creek

Frogs and turtles are also harvested in the South Chickamauga Creek. This is estimated at 10 pounds per year.

18. **Sensitive Environments (see Figures A-2 and A-3):**

Downriver sensitive environments are indicated below:

(a) Elise Chapin Wildlife Sanctuary [4]
(b) Audobon Society Wildlife Refuge (Maclellan Island) [5]
(c) Chickamauga and Chattanooga National Military Park [4]
(d) Wetland areas along the South Chickamauga Creek, Nickajack Lake and Chickamauga Lake

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19. **Linear Frontage of Wetlands**

The linear frontage along the South Chickamauga Creek and other designated wetlands is approximately 160,000 feet.

20. **Location and Population of People within 200 feet of Source**

Based on a population of 175 people on assignment at the station during any given time, the exposure to the source (within 200 feet) can be estimated at two thirds of 175 or 109 people due to the location of occupied buildings.

21. **Terrestrial Sensitive Environments On-site**

No terrestrial sensitive environments have been designated on-site.

22. **Accessibility to Human Population**

As designated in EPA Docket Table 8, the area is "accessible, with no public recreation use." Accessibility is restricted to employees only.

23. **Total Number of People in following distance rings from source**

0 - 1/4 mile	175 (maximum station capacity)
1/4 - 1/2 mile	450
1/2 - 1 mile	1,600
1 - 2 miles	9,700
2 - 3 miles	25,000
3 - 4 miles	38,000

Assumptions: The 0 - 1/4 mile distance ring encloses the base area and its population is, therefore, based on a maximum station capacity of 175 individuals. Further population calculations are based on homogeneous diffusion through the area, utilizing 1990 census tracts, drawing distance rings, estimating percentage of area enclosed in ring, and taking a percentage of population for the given population tract.

24. **Gaseous Containment, Source Type, and Particulate Containment (see Figures A-4 and A-5)**

Gaseous containment designation from EPA Docket Table 9: "All situations except those specifically listed below".

Source type as described in Table 10: "Contaminated soil (excluding land treatment)".

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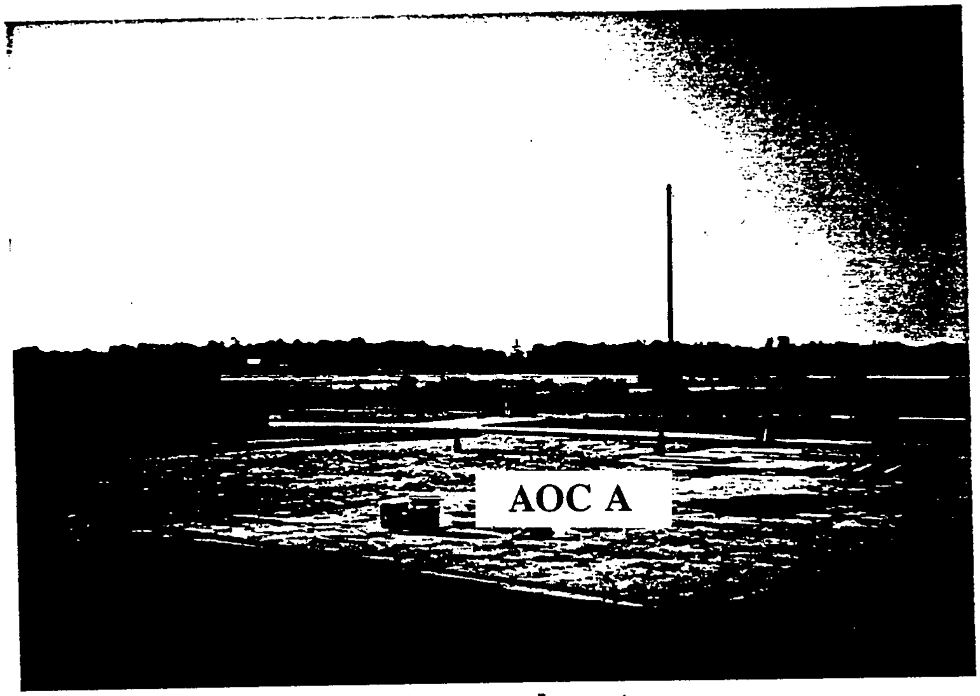
FIGURE A-4
Area of Concern A (located behind Building 100)



facing northwest

FIGURE A-5
Area of Concern A (located behind building 100)

facing northeast

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Particulate containment designated from Table 11: "All situations except those specifically listed below".

25. **Wetlands**

Wetland areas are located along the South Chickamauga Creek and comprise an approximate area of 120 acres.

28. **Remedial Actions**

No remedial actions have taken place at the site.

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REFERENCES

[1] Hoos, Anne B.,"Recharge Rates and Aquifer Hydraulic Characteristics for Selected Drainage Basins in Middle and East Tennessee", Water-Resources Investigations Report 90-4015, U.S. Geological Survery in cooperation with Tennessee State Planning Office and Tennessee, Department of Health and Environment, 1990

[2] Population and Housing Statistics by Municipalities 1990, Chattanooga/Hamilton County Regional Planning Commission, April 1992

[3] Surface Waters of Tennessee, State of Tennessee Division of Geology, USGS Bulletin 40, 1931

[4] East Chattanooga Quadrangle, 35085-A2-TF-024

[5] National Wetlands Inventory Map for Chattanooga Tennessee, U.S. Department of the Interior, Fish and Wildlife Service, 1987

Table 1

All Sources
(Except Surface Impoundment, Land Treatment, Containers, and Tanks)

Evidence of hazardous substance migration from source area (i.e., source area includes source and any associated containment structures).

No liner

No evidence of hazardous substance migration from source area, a liner, <u>and</u>:

(a) None of the following present (1) maintained engineered cover, or (2) functioning and maintained run-on control system and run-off management system, or (3) functioning leachate collections and removal system immediately above liner.

(b) Any one of the three items in (a) present.

(c) Any two of the items in (a) present.

(d) All three items in (a) present plus a functioning ground water monitoring system.

(e) All items in (d) present plus no bulk or non-containerized liquids nor materials containing free liquids deposited in source area.

No evidence of hazardous substance migration from source area, double liner with functioning leachate collection and removal system above and between liners, functioning ground water monitoring system, <u>and</u>:

(f) Only one of the following deficiencies present in containment (1) bulk or noncontainerized liquids or materials containing free liquids deposited in source area, or (2) no or nonfunctioning or nonmaintained run-on control system and run-off management system, or (3) no or nonmaintained engineered cover.

(g) None of the deficiencies in (f) present.

Source area inside or under maintained intact structure that provides protection from precipitation so that neither run-off nor leachate is generated, liquids or materials containing free liquids not deposited in source area, and functioning and maintained run-on control present.

Surface Impoundment

Evidence of hazardous substance migration from surface impoundment

No liner

Free liquids present with either no diking, unsound diking, or diking that is not regularly inspected and maintained

No evidence of hazardous substance migration from surface impoundment, free liquids present, sound diking that is regularly inspected and maintained, adequate freeboard, <u>and</u>:

(a) Liner

(b) Liner with functioning leachate collection and removal system below liner, and functioning ground water monitoring system.

(c) Double liner with functioning leachate collection and removal system between liners, and functioning ground water monitoring system.

No evidence of hazardous substance migration from surface impoundment and all free liquids eliminated at closure (either by removal of liquids or solidification of remaining wastes and waste residues).

Land Treatment

Evidence of hazardous substance migration from land treatment zone

No functioning and maintained run-on control and run-off management system

No evidence of hazardous substance migration from land treatment zone, <u>and</u>:

(a) Functioning and maintained run-on control and run-off management system

(b) Functioning and maintained run-on control and run-off management system, and vegetative cover established over entire land treatment area.

(c) Land treatment area maintained in compliance with 40 CFR 264.280.

Containers

All containers buried

Evidence of hazardous substance migration from container area (i.e., container area includes containers and any associated containment structures).

No liner (or no essentially impervious base) under container area

No diking (or no similar structure) surrounding container area

Diking surrounding container area unsound or not regularly inspected and maintained.

No evidence of hazardous substance migration from container area, container area surrounded by sound diking that is regularly inspected and maintained, <u>and</u>:

(a) Liner (or essentially impervious base) under container area

(b) Essentially impervious base under container area with liquids collection and removal system

(c) Containment system includes essentially impervious base, liquids collection system, sufficient capacity to contain 10 percent of volume of all containers, and functioning and maintained run-on control; plus functioning ground water monitoring system, and spilled or leaked hazardous substances and accumulated precipitation removed in a timely manner to prevent overflow of collection system, at least weekly inspection of containers, hazardous substances in leaking or deteriorating containers transferred to containers in good condition, and containers sealed except when waste is added or removed.

(d) Free liquids present containment system has sufficient capacity to hold total volume of all containers and to provide adequate freeboard, single liner under container area with functioning leachate collection and removal system below liner, and functioning ground water monitoring system.

(e) Same as (d) except: double liner under container area with functioning leachate collection and removal system between liners.

Containers inside or under maintained intact structure that provides protection from precipitation so that neither run-off nor leachate would be generated from any unsealed or ruptured containers, liquids or materials containing free liquids not deposited in any container, and functioning and maintained run-on control present.

No evidence of hazardous substance migration from container area, containers leaking, and all free liquids eliminated at closure (either by removal of liquids or solidification of remaining wastes and waste residue).

Tank

Below-ground tank

Evidence of hazardous substance migration from tank area (i.e., tank area includes tank, ancillary equipment such as piping, and any associated containment structures).

Tank and ancillary equipment not provided with secondary containment, (e.g., liner under tank area, vault system, double wall).

No diking (or no similar structure) surrounding tank and ancillary equipment.

Diking surrounding tank and ancillary equipment unsound or not regularly inspected and maintained.

No evidence of hazardous substance migration from tank area, tank and ancillary equipment surrounded by sound diking that is regularly inspected and maintained, and:

(a) Tank and ancillary equipment provided with secondary containment

(b) Tank and ancillary equipment provided with secondary containment with leak detection and collection system

(c) Tank and ancillary equipment provided with secondary containment system that detects and collects spilled or leaked hazardous substances and accumulated precipitation and has sufficient capacity to contain 110 percent of volume of largest tank within containment area, spilled or leaked hazardous substances and accumulated precipitation removed in a timely manner, at least weekly inspection of tank and secondary containment system, all leaking or unfit-for-use tank systems promptly responded to, and functioning ground water monitoring system.

(d) Containment system has sufficient capacity to hold total volume of all tanks within the tank containment area and to provide adequate freeboard, single liner under tank containment area with functioning leachate collection and removal system below liner, and functioning ground water monitoring system.

(e) Same as (d) except double liner under tank containment area with functioning leachate collection and removal system between liners.

Tank is above ground, and inside or under maintained intact structure that provides protection from precipitation so that neither run-off nor leachate would be generated from any material released from tank, liquids or materials containing free liquids not deposited in any tank, and functioning and maintained run-on control present.

Table 2

All Sources
(Except Surface Impoundment, Land Treatment, Containers, and Tanks)

Evidence of hazardous substance migration from source area (i.e., source area includes source and any associated containment structures).

No evidence of hazardous substance migration from source area and:

(a) Neither of the following present (1) maintained engineered cover, or (2) functioning and maintained run-on control system and run-off management system.

(b) Any one of the two items in (a) present.

(c) Any two of the following present. (1) maintained engineered cover, or (2) functioning and maintained run-on control system and run-off management system, or (3) liner with functioning leachate collections and removal system immediately above liner.

(d) All items in (c) present.

(e) All items in (c) present, plus no bulk or non-containerized liquids nor materials containing free liquids deposited in source area.

No evidence of hazardous substance migration from source area, double liner with functioning leachate collection and removal system above and between liners, and:

(f) Only one of the following deficiencies present in containment (1) bulk or noncontainerized liquids or materials containing free liquids deposited in source area, or (2) no or nonfunctioning or nonmaintained run-on control system and run-off management system, or (3) no or nonmaintained engineered cover.

(g) None of the deficiencies in (f) present.

Source area inside or under maintained intact structure that provides protection from precipitation so that neither run-off nor leachate is generated, liquids or materials containing free liquids not deposited in source area, and functioning and maintained run-on control present.

Surface Impoundment

Evidence of hazardous substance migration from surface impoundment

Free liquids present with either no diking, unsound diking, or diking that is not regularly inspected and maintained

No evidence of hazardous substance migration from surface impoundment, free liquids present, sound diking that is regularly inspected and maintained, adequate freeboard, and:

(a) No liner

(b) Liner

(c) Liner with functioning leachate collection and removal system below liner

(d) Double liner with functioning leachate collection and removal system between liners

No evidence of hazardous substance migration from surface impoundment and all free liquids eliminated at closure (either by removal of liquids or solidification of remaining wastes and waste residues).

Land Treatment

Evidence of hazardous substance migration from land treatment zone

No functioning and maintained run-on control and run-off management system

No evidence of hazardous substance migration from land treatment zone, and:

(a) Functioning and maintained run-on control and run-off management system

(b) Functioning and maintained run-on control and run-off management system, and vegetative cover established over entire land treatment area.

(c) Land treatment area maintained in compliance with 40 CFR 264.280.

Containers

All containers buried

Evidence of hazardous substance migration from container area (i.e., container area includes containers and any associated containment structures).

No diking (or no similar structure) surrounding container area.

Diking surrounding container area unsound or not regularly inspected and maintained.

No evidence of hazardous substance migration from container area and container area surrounded by sound diking that is regularly inspected and maintained.

No evidence of hazardous substance migration from container area, container area surrounded by sound diking that is regularly inspected and maintained, <u>and</u>:

(a) Essentially impervious base under container area with liquids collection and removal system;

(b) Containment system includes essentially impervious base, liquids collection system, sufficient capacity to contain 10 percent of volume of all containers, and functioning and maintained run-on control; and spilled or leaked hazardous substances and accumulated precipitation removed in a timely manner to prevent overflow of collection system, at least weekly inspection of containers, hazardous substances in leaking or deteriorating containers transferred to containers in good condition, and containers sealed except when waste is added or removed.

(c) Free liquids present containment system has sufficient capacity to hold total volume of all containers and to provide adequate freeboard and single liner under container area with functioning leachate collection and removal system below liner.

(d) Same as (c) except: double liner under container area with functioning leachate collection and removal system between liners.

Containers inside or under maintained intact structure that provides protection from precipitation so that neither run-off nor leachate would be generated from any unsealed or ruptured containers, liquids or materials containing free liquids not deposited in any container, and functioning and maintained run-on control present.

No evidence of hazardous substance migration from container area, containers leaking, and all free liquids eliminated at closure (either by removal of liquids or solidification of remaining wastes and waste residue).

Tank

Below-ground tank

Evidence of hazardous substance migration from tank area (i.e., tank area includes tank, ancillary equipment such as piping, and any associated containment structures).

No diking (or no similar structure) surrounding tank and ancillary equipment.

Diking surrounding tank and ancillary equipment unsound or not regularly inspected and maintained.

No evidence of hazardous substance migration from tank area and tank and ancillary equipment surrounded by sound diking that is regularly inspected and maintained.

No evidence of hazardous substance migration from tank area, tank and ancillary equipment surrounded by sound diking that is regularly inspected and maintained, <u>and</u>:

(a) Tank and ancillary equipment provided with secondary containment (e.g., liner under tank area, vault system, double-wall) with leak detection and collection system.

(b) Tank and ancillary equipment provided with secondary containment system that detects and collects spilled or leaked hazardous substances and accumulated precipitation and has

sufficient capacity to contain 110 percent of volume of largest tank within containment area, spilled or leaked hazardous substances and accumulated precipitation removed in a timely manner, at least weekly inspection of tank and secondary containment system, and all leaking or unfit-for-use tank systems promptly responded to.

(c) Containment system has sufficient capacity to hold total volume of all tanks within the tank containment area and to provide adequate freeboard, and single liner under tank containment area with functioning leachate collection and removal system below liner.

(d) Same as (d) except double liner under tank containment area with functioning leachate collection and removal system between liners.

Tank is above ground, and inside or under maintained intact structure that provides protection from precipitation so that neither run-off nor leachate would be generated from any material released from tank, liquids or materials containing free liquids not deposited in any tank, and functioning and maintained run-on control present.

Table 3

Surface Soil Description

Coarse-textured soils with high infiltration rates (for example, sands, loamy sands)
Medium-textured soils with moderate infiltration rates (for example, sandy loams, loams)
Moderate fine-textured soils with low infiltration rates (for example, silty loams, silts, sandy clay loams)
Fine-textured soils with very low infiltration rates (for example, clays, sandy clays, silty clay loams, clay loams, silty clays); or impermeable surfaces (for example, pavement)

Table 4

Floodplain Categories

Source floods annually
Source in 10-year floodplain
Source in 100-year floodplain
Source in 500-year floodplain
None of the above

Table 5

Flood Containment

Documentation that containment at the source is designed, constructed, operated, and maintained to prevent a washout of hazardous substances by the flood being evaluated (see floodplain category)

Table 6

Sensitive Environments

Critical habitat[a] for Federal designated endangered or threatened species
Marine Sanctuary
National Park
Designated Federal Wilderness Area
Areas identified under Coastal Zone Management Act[b]
Sensitive areas identified under National Estuary Program[c] or Near Coastal Waters Program[d]
Critical areas identified under the Clean Lakes Program[e]
National Monument[f]
National Seashore Recreational Area
National Lakeshore Recreational Area
Habitat known to be used by Federal designated or proposed endangered or threatened species
National Preserve
National or State Wildlife Refuge
Unit of Coastal Barrier Resources System
Coastal Barrier (undeveloped)
Federal land designated for protection of natural ecosystems
Administratively proposed Federal Wilderness Area
Spawning areas critical[g] for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters
Migratory pathways and feeding areas critical for maintenance of anadromous fish species within reaches or areas in lakes or coastal tidal waters in which the fish spend extended periods of time
Terrestrial areas utilized for breeding by large or dense aggregations of animals[h]
National river reach designated as Recreational
Habitat known to be used by State designated endangered or threatened species
Habitat known to be used by species under review as to its Federal endangered or threatened status
Coastal Barrier (partially developed)
Federal designated Scenic or Wild River
State land designated for wildlife or game management
State designated Scenic or Wild River
State designated Natural Areas
Particular areas, relatively small in size, important to maintenance of unique biotic communities
State designated areas for projection or maintenance of aquatic life[i]

[a]Critical habitat as defined in 50 CFR 424.02
[b]Areas identified in State Coastal Zone Management plans as requiring protection because of ecological value
[c]National Estuary Program study areas (Subareas within subareas) identified in Comprehensive Conservation and Management Plans as requiring protection because they support critical life stages of key estuarine species (Section 320 of Clean Water Act, as amended)
[d]Near Coastal Waters as defined in Section 104(b)(3), 304(1), 319, and 320 of Clean Water Act, as amended.
[e]Clean Lakes Program critical areas (subareas within lakes, or in some cases entire small lakes) identified by State Clean Lake Plans as critical habitat (Section 314 of Clean Water Act, as amended)
[f]Use only for air migration pathway.
[g]Limit to areas described as being used for intense or concentrated spawning by a given species.
[h]For the air migration pathway, limited to terrestrial vertebrate species. For the surface water migration pathway, limit to terrestrial vertebrate species with aquatic or semiaquatic foraging habits.
[i]Areas designated under Section 305(a) of Clean Water Act, as amended.

Table 7

Terrestrial Sensitive Environments

Terrestrial critical habits[a] for Federal designated or threatened species
National Park
Designated Federal Wilderness Area
National Monument
Terrestrial habitat known to be used by Federal designated or proposed endangered or threatened species
National Preserve (terrestrial)
National or State Terrestrial Wildlife Refuge
Federal land designated for protection of natural ecosystems
Administratively proposed Federal Wilderness Area
Terrestrial areas utilized for breeding by large or dense aggregations of animals[b]
Terrestrial habitat known to be used by State designated endangered or threatened species
Terrestrial habitat known to be used by species under review as to its Federal endangered or threatened status
State lands designated for wildlife or game management
State designated Natural Areas
Particular areas, relatively small in size, important to maintenance of unique biotic communities

[a]Critical habitat as defined in 50 CFR 42
[b]Limit to vertebrate species.

Table 8

Area of Observed Contamination

Designated recreational area

Regularly used for public recreation (for example, fishing, hiking, softball)

Accessible and unique recreational area (for example, vacant lots in urban area)

Moderately accessible (may have some access improvements - for example, gravel road), with some public recreation use

Slightly accessible (for example, extremely rural area with no road improvement), with some public recreation use

Accessible, with no public recreation use

Surrounding by maintained fence or combination of maintained fence and natural barriers

Physically inaccessible to public, with no evidence of public recreation use

---

Table 9

Gas Containment Description

All situations except those specifically listed below

Evidence of biogas release

Active fire within source

Gas collection/treatment system functioning, regularly inspected, maintained, and completely covering source

Source substantially surrounded by engineered windbreak and no other containment specifically described in this table applies

Source covered with essentially impermeable, regularly inspected, maintained cover

Uncontaminated soil cover > 3 feet:

- Source substantially vegetated with little exposed soil
- Source lightly vegetated with much exposed soil
- Source substantially devoid of vegetation

Uncontaminated soil cover >= 1 foot and <= 3 feet:

- Source heavily vegetated with essential no exposed soil
  - Cover soil type resistant to gas migration[a]
  - Cover soil type not resistant to gas migration[a] or unknown
- Source substantially vegetated with little exposed soil and cover soil type resistant to gas migration[a]
- Other

Uncontaminated soil cover < 1 foot:

- Source heavily vegetated with essentially no exposed soil and cover soil type resistant to gas migration[a]
- Other

Totally or partially enclosed within structurally intact building and no other containment specifically described in this table applies.

Source consists solely of intact, sealed containers:

- Totally protected from weather by regularly inspected, maintained cover
- Other

---

[a]Consider moist fine-grained and saturated coarse-grained soils resistant to gas migration, consider all other soils nonresistant.

Table 10

Source Type

Active fire area

Burn pit

Containers or tanks (buried/below ground):

- Evidence of biogas release
- No evidence of biogas release

Containers or tanks, not elsewhere specified

Contaminated soil (excluding land treatment)

Landfarm/land treatment

Landfill:

- Evidence of biogas release
- No evidence of biogas release

Pile:

- Tailing pile
- Scrap metal or junk pile
- Trash pile
- Chemical waste pile
- Other waste pile

Surface impoundments (buried/backfilled):

- Evidence of biogas release
- No evidence of biogas release

Surface impoundment (not buried/backfilled):

- Dry
- Other

Other types of sources, not elsewhere specified

Table 11

Particulate Containment Description

All situations except those specifically listed below

Source contains only particulate hazardous substances totally covered by liquids

Source substantially surrounded by engineered windbreak and no other containment specifically described in this table applies

Source covered with essentially impermeable, regularly inspected, maintained cover

Uncontaminated soil cover > 3 feet:

- Source substantially vegetated with little or no exposed soil
- Source lightly vegetated with much exposed soil
- Source substantially devoid of vegetation

Uncontaminated soil cover >= 1 foot and <= 3 feet:

- Source heavily vegetated with essential no exposed soil
  - Cover soil type resistant to gas migration[a]
  - Cover soil type not resistant to gas migration[a] or unknown
- Source substantially vegetated with little exposed soil and cover soil type resistant to gas migration[a]
- Other

Uncontaminated soil cover < 1 foot:

- Source substantially vegetated with essentially no exposed soil and cover soil type resistant to gas migration[a]
- Other

Totally or partially enclosed within structurally intact building and no other containment specifically described in this table applies.

Source consists solely of containers:

- All containers contain only liquids
- All containers intact, seated, and totally protected from weather by regularly inspected, maintained cover
- All containers intact and sealed
- Other

---

[a]Consider moist fine-grained and saturated coarse-grained soils resistant to gas migration, consider all other soils nonresistant.